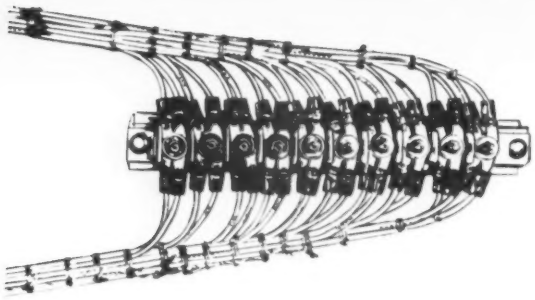
July 18, 1960

Aviation Week and Space Technology

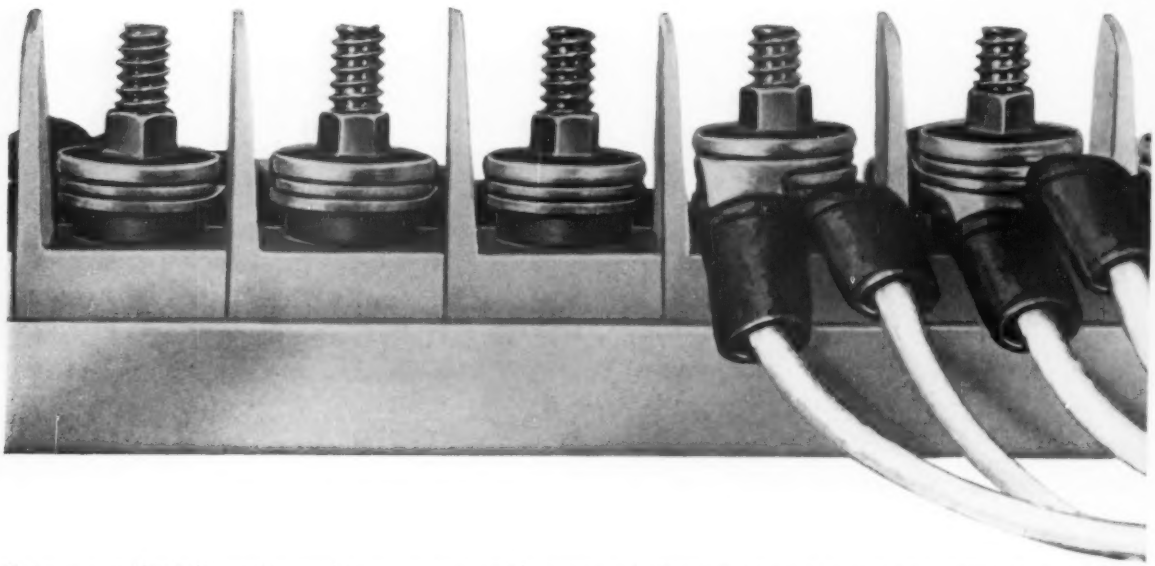
Pilot Report On Convair Turboprop

First American Airlines Boeing 720

© 1960 Kaynar Mfg. Co., Inc.



KAYLOCK® NUT VITAL LINK IN NEW TERMINAL BLOCK



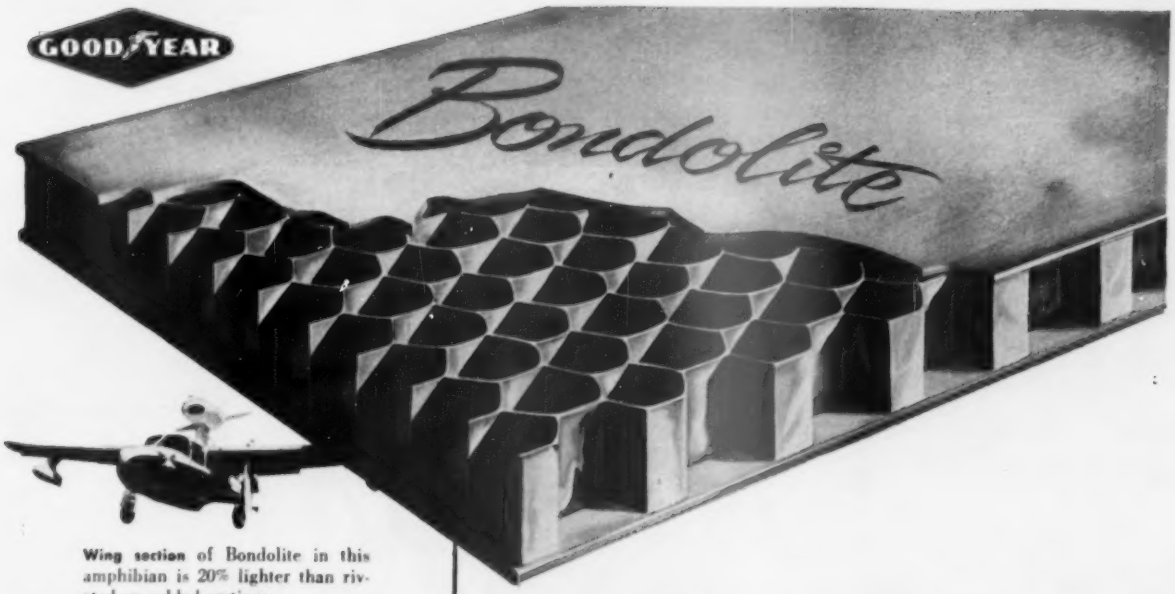
Using a new Kaylock® captive washer nut to save weight, space and assembly time and to eliminate loose washer problems, Lockheed Aircraft Corporation has achieved the first major terminal block improvement in 20 years. The revolutionary LS 7000 Lockheed terminal block, initially used on the Electra, is much smaller and lighter than the old AN part it replaces.

The Kaylock HW 19373 self-locking nut with integral, free-spinning metal washer permits terminals to be spaced closer together, requires less wrench clearance and speeds up assembly by eliminating extra motions ordinarily required to attach washer to bolt. It's safer, too! No chance of dropping washers into places where they might do damage. If you have a special locknut problem you would like to have solved, a Kaylock sales engineer is as near as your phone. Call him today.

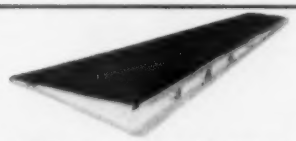
Kaylock.
first in lightweight locknuts

KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Terminal Annex, Los Angeles 54, Calif. Branch offices, warehouses & representatives in Wichita, Kansas; New York, N.Y.; Atlanta, Ga.; Renton, Wash. Canadian Distributor: Abercorn Aero, Ltd., Montreal, Quebec.

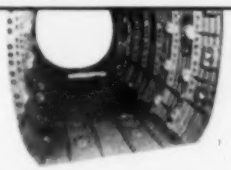
GOODYEAR



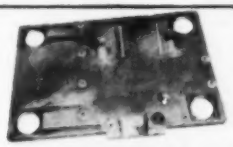
Wing section of Bondolite in this amphibian is 20% lighter than riveted or welded sections.



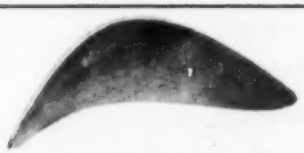
Rudder trailing edge of Bondolite is 20% lighter than other constructions.



Helicopter floor made of Bondolite is 25% lighter than riveted floor it replaced.



Mounting board for airborne electronic equipment is fabricated of Bondolite. Weight savings? 35%!



Airborne radar reflector of Bondolite is lighter by 35% than conventional reflector.

HERE'S A "WEIGHT REDUCER" THAT ADDS POUNDS TO YOUR PAY LOAD!

It's Bondolite by Goodyear Aircraft—with one of the highest strength-weight ratios of any fabricated material. Missile and plane makers use this light but strong sandwich material for decks, bulkheads, mounting boards, capsules, containers—wherever they want great strength with no sacrifice in pay load—or more pay load for the same weight.

Strong? One type of Bondolite actually withstands pressure of *6,000 psi* without bending! Yet you can work Bondolite with ordinary shop tools.

Goodyear engineers Bondolite to your exact specifications—in many sizes and shapes, from ⅛" to 5" thick (even thicker on special order), to the most exact tolerances. There's a variety of cores for a variety of applications—metal foil, paper, plastic, end-grain balsa, stainless steel. And there's a wide choice of surface materials—paper, fiberglass, aluminum, stainless steel, titanium, plywood, fancy veneers. Bondolite can also be pattern-embossed for extra rigidity and wear-resistance or for decorative values.

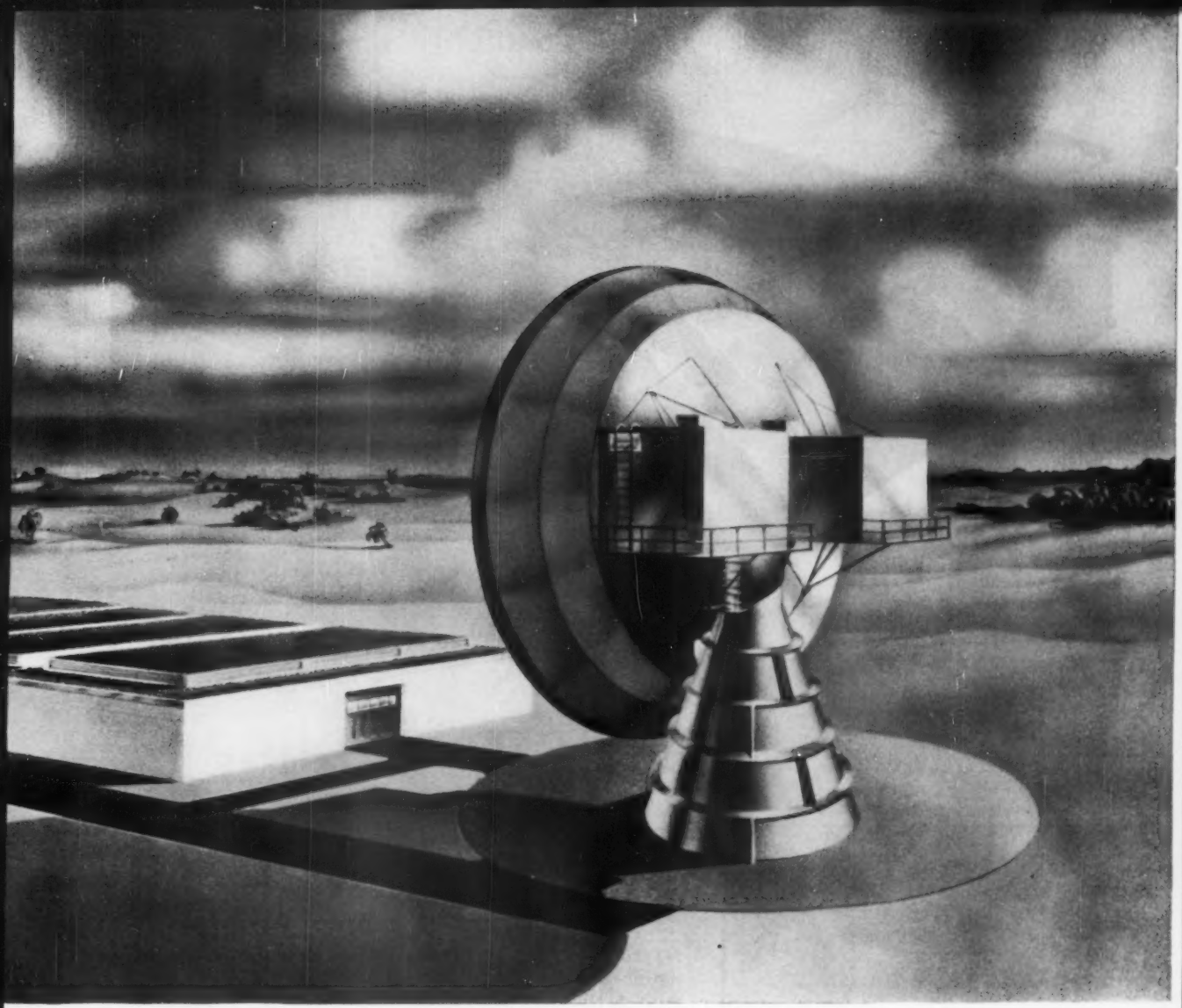
Save weight—retain strength—specify Bondolite by Goodyear for scores of airplane and missile parts—floor panels, substructures, leading edges, compartment doors. For full details write on company letterhead to Goodyear Aircraft Corporation, Aero-Mechanical Division, Dept. 916AS, Akron 15, Ohio.

Bondolite—T. M. Goodyear Aircraft Corporation, Akron 15, Ohio

Lots of good things come from

GOODYEAR AIRCRAFT

Plants in Akron, Ohio, and Litchfield Park, Arizona



Five-story high antenna for Pincushion radar will be part of a new Advanced Research Projects Agency installation to be set up in mid-Pacific.

A unique radar designed to track and identify the warhead of ICBMs thousands of miles away is now being developed by Raytheon.

Designated "Pincushion", because of its microwave beam pattern formation, the 80-ton Raytheon radar will be part of Project Defender, ARPA's program to develop advanced anti-ICBM concepts.

RAYTHEON COMPANY, WALTHAM, MASS.

RAYTHEON

EXCELLENCE IN ELECTRONICS

AVIATION CALENDAR

July 28-29—Seventh Annual Symposium on Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.

Aug. 1-3—Fourth Global Communications Symposium, Statler Hilton Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers; U. S. Army Signal Corps.

Aug. 1-3—"Future of Manned Military Aircraft" (Classified Meeting), Institute of the Aeronautical Sciences, El Cortez Hotel, San Diego, Calif.

Aug. 1-4—Annual Technical Symposium and Exhiborama, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 2-11—27th Annual U. S. National Soaring Championships, Ector County Airport, Odessa, Tex.

Aug. 8-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.

Aug. 8-12—1960 Pacific General Meeting, American Institute of Electrical Engineers, El Cortez Hotel, San Diego, Calif.

Aug. 14-17—Fourth National Heat Transfer Conference and Exhibit, Statler Hilton Hotel, Buffalo, N. Y. Sponsors: American Institute of Chemical Engineers; American Society of Mechanical Engineers.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 16-18—Fourth Annual Tri-Service Conference on Biological Effects of Microwave Radiation, New York University Post-Graduate Medical School, NYU Medical Center, N.Y.C. Sponsor: Air Research and Development Command.

Aug. 18-19—Second International Symposium on Submarine and Space Medicine, Laboratory of Aviation and Naval Medicine, Karolinska Institute, Stockholm.

Aug. 18-19—Electronic Packaging Symposium, University of Colorado, Boulder.

(*Continued on page 6*)

AVIATION WEEK and Space Technology

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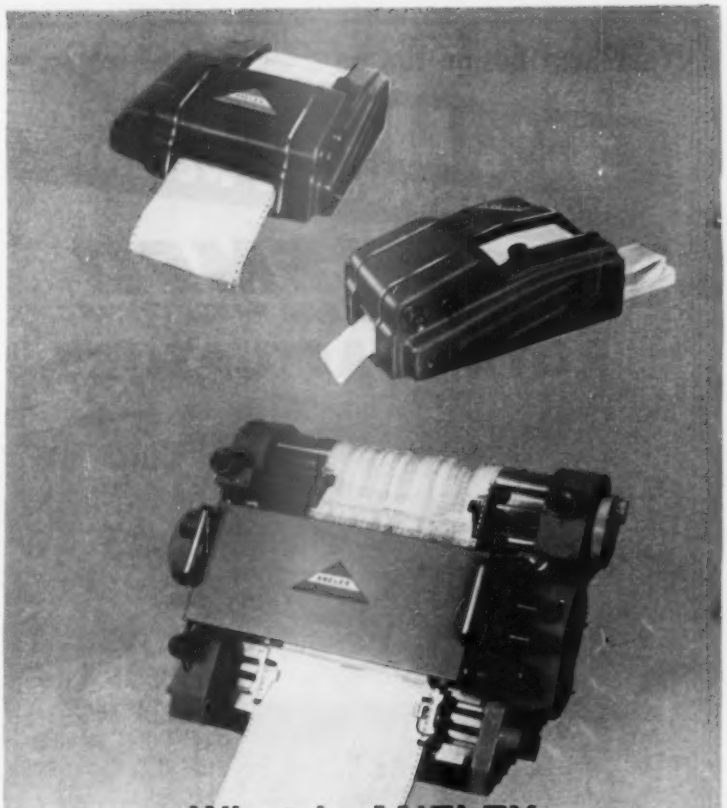

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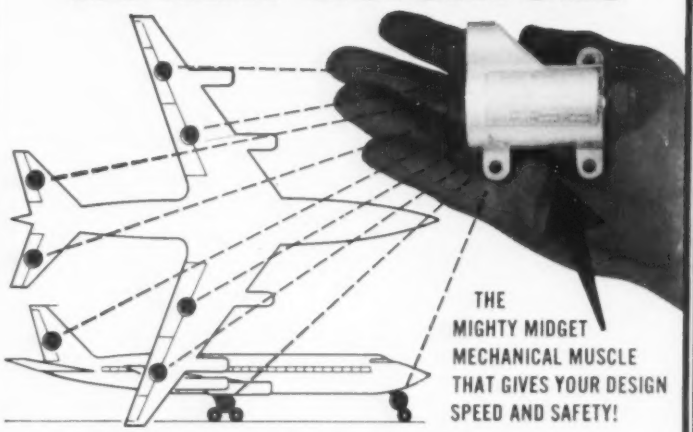

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AVIATION CALENDAR

(Continued from page 5)

Aug. 23-25—1960 Cryogenic Engineering Conference, University of Colorado.

Aug. 23-26—Western Electronic Show & Convention, Los Angeles Memorial Sports Arena, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 1—Symposium on Rocket and Satellite Instrumentation, Society of Instrument Technology and British Interplanetary Society, London, England.

Sept. 4-5—Civilian, Closed-Course Airplane Races, Lakefront Airport, Cleveland.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 7-9—Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Instrument Society of America; American Society of Mechanical Engineers; American Institute of Electrical Engineers; Institute of Radio Engineers; American Institute of Chemical Engineers.

Sept. 8-9—1960 Engine and Operations Symposium, Airwork Corp., Millville, N. J.

Sept. 12-13—Sixth Annual Titanium Metallurgy Conference, New York University's College of Engineering, Bronx, N. Y.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 25-27—24th Annual Convention, International Northwest Aviation Council, Harrison Hot Springs, British Columbia.

Sept. 27-30—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica. Cosponsors: USAF; U. S. Army; U. S. Navy; NASA; AEC.

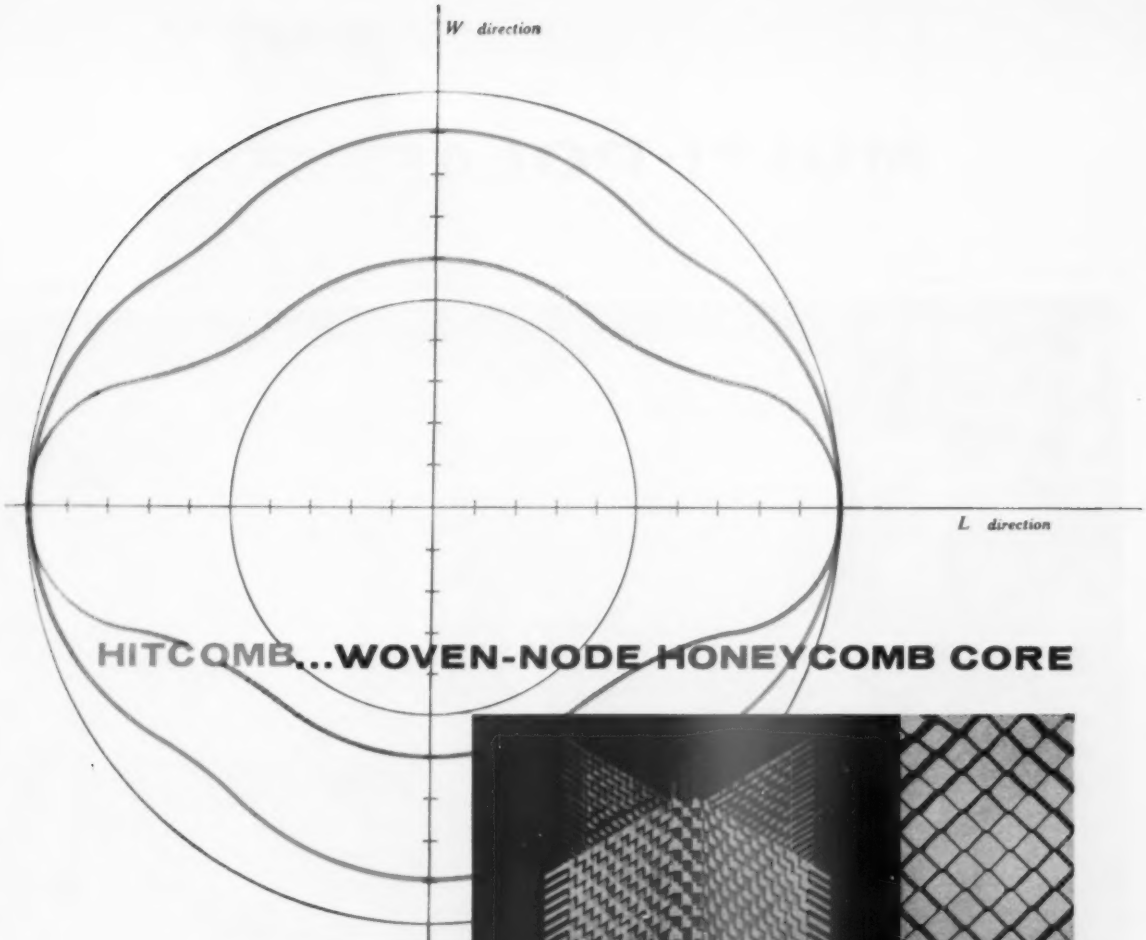
Oct. 3-5—Sixth National Communications Symposium, Institute of Radio Engineers, Utica, N. Y.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

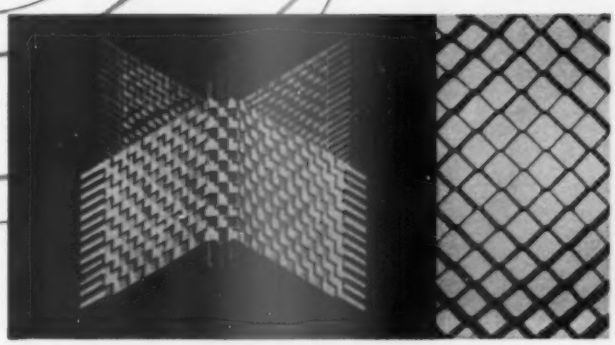
Oct. 3-5—National Midwestern Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.

Oct. 3-5—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Assn., Sheraton-Palace Hotel, San Francisco.

Oct. 10-14—Society of Automotive Engineers National Aeronautic Meeting, Ambassador Hotel, Los Angeles, Calif.



HITCOMB...WOVEN-NODE HONEYCOMB CORE



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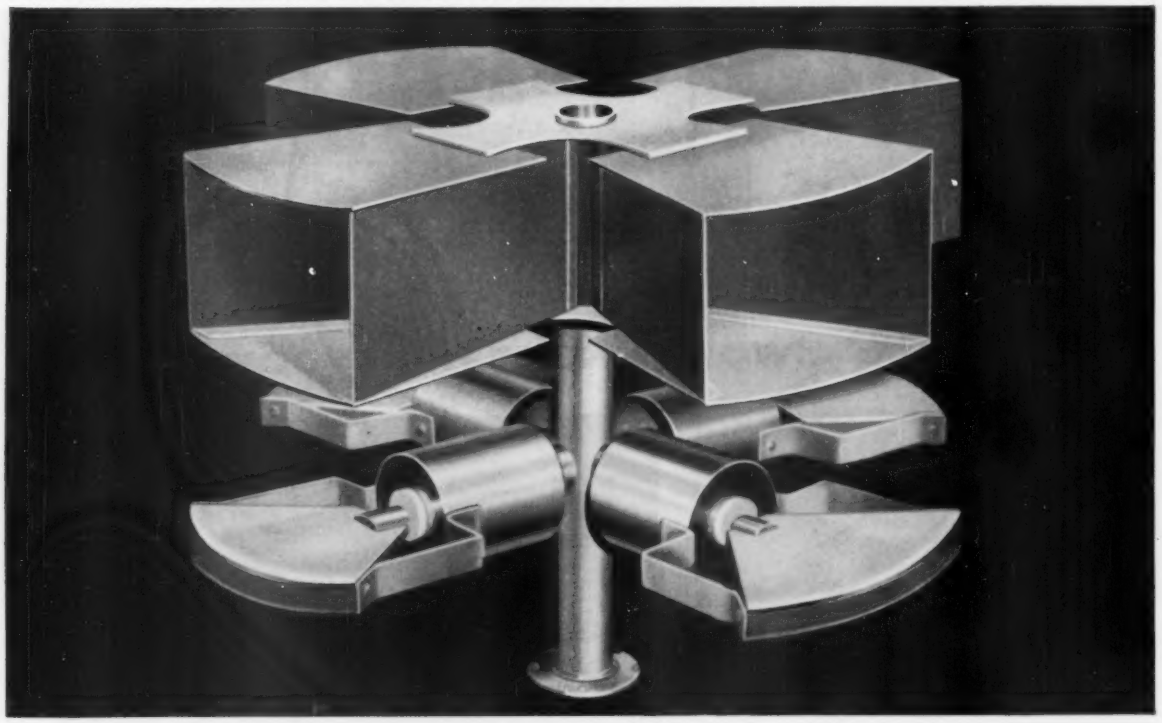

Automatic flexibility at no additional cost. Now, with *one* antenna, you can select the polarization mode best suited for a particular missile or space vehicle. Selection may be done remotely, if desired. Direct application can be found in communicating, tracking, telemetering, or command control fields. This Chance Vought Electronics antenna development eliminates the need for changing elements to conform to polarization changes from a missile or satellite source. Yet its cost is no greater than that of a comparable helical design.

Low-drag, lightweight design. With the Multi-Polarized System, element height reduction is four to one when compared to an equivalent helical array. Weight and drag savings in the Vought antenna allow the use of a lightweight pedestal and offer broad location freedom. The Pacific Missile Range's first tracking vessel, U.S.S. Skidmore Victory, is being equipped with Vought's Multi-Polarized Antenna Systems.

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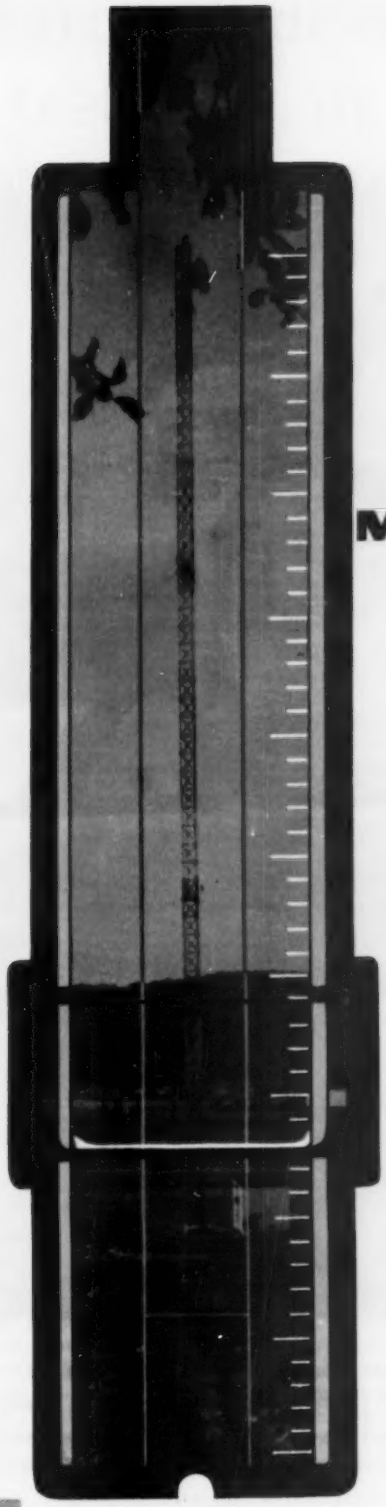

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Versatility to handle any metalworking job is evidenced by this plant's production of propellant trucks, rocket launchers, crane trucks, marine gears, cargo winches, airframe parts, towers, and a complete line of oil field equipment. Illustrated is a typical 700′ triangular tower built by Continental-Emsco.

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WHAT WAS SINGER DOING AT PASADENA? Major underwater ordnance projects are underway at the Pasadena Facility of the U. S. Naval Ordnance Test Station, China Lake, California. Here Singer worked closely with scientific and engineering teams in vehicle water entry studies. Representatives of the Singer Military Products Division are busy working with civilian and military teams engaged in equally critical defense work at bases all over the country. A division of The Singer Manufacturing Company, SMPD is composed of Singer-Bridgeport, Diehl Manufacturing Company, and HRB-Singer.

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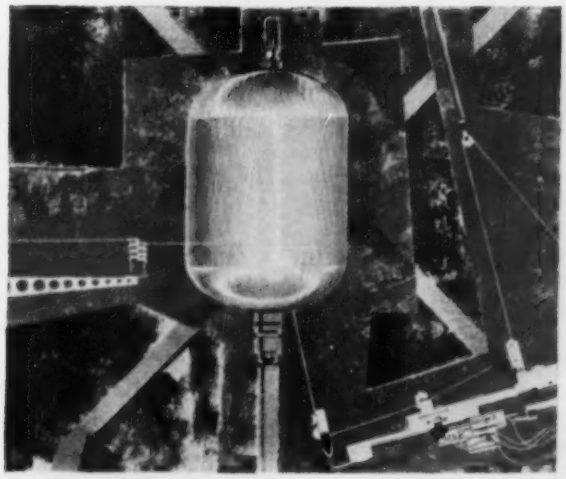
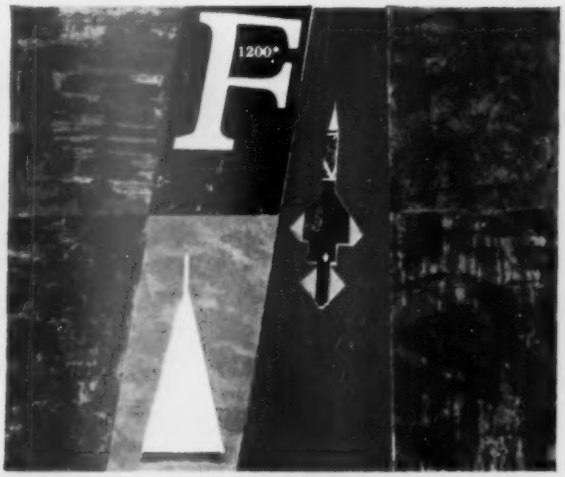
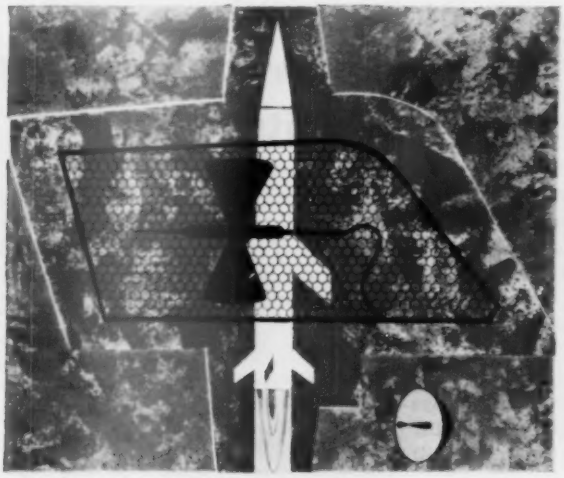


ROCKET MOTOR CASE. Brunswick's exclusive bi-axial Strickland "B" Process of fiber glass filament winding gives S-D ratio to 2,000,000, provides up to 7,500,000 psi modulus. By laying down filaments under tension, SBP excels in making cylindrical shapes, unusual contours, large range of sizes. Pre-stressing gives exactly controlled uniformity.



RADOMES. Brunswick's non-metallic materials boost heat tolerance of radomes and nose cones to 1000-1200°F for limited exposures. SBP filament winding gives highest-ever strength-to-weight ratios with significant weight savings over usual structures. With unmatched electrical uniformity, Brunswick builds to tightest tolerance for dialectric constants and compound configurations.

HONEYCOMB ASSEMBLIES now developed by Brunswick can support two million times their own weight. Brunswick research has created honeycomb assemblies of paper, fiber glass, aluminum and various combinations of these materials. Using the most advanced adhesive systems, these assemblies can be formed in compound curvatures with extremely close tolerances.



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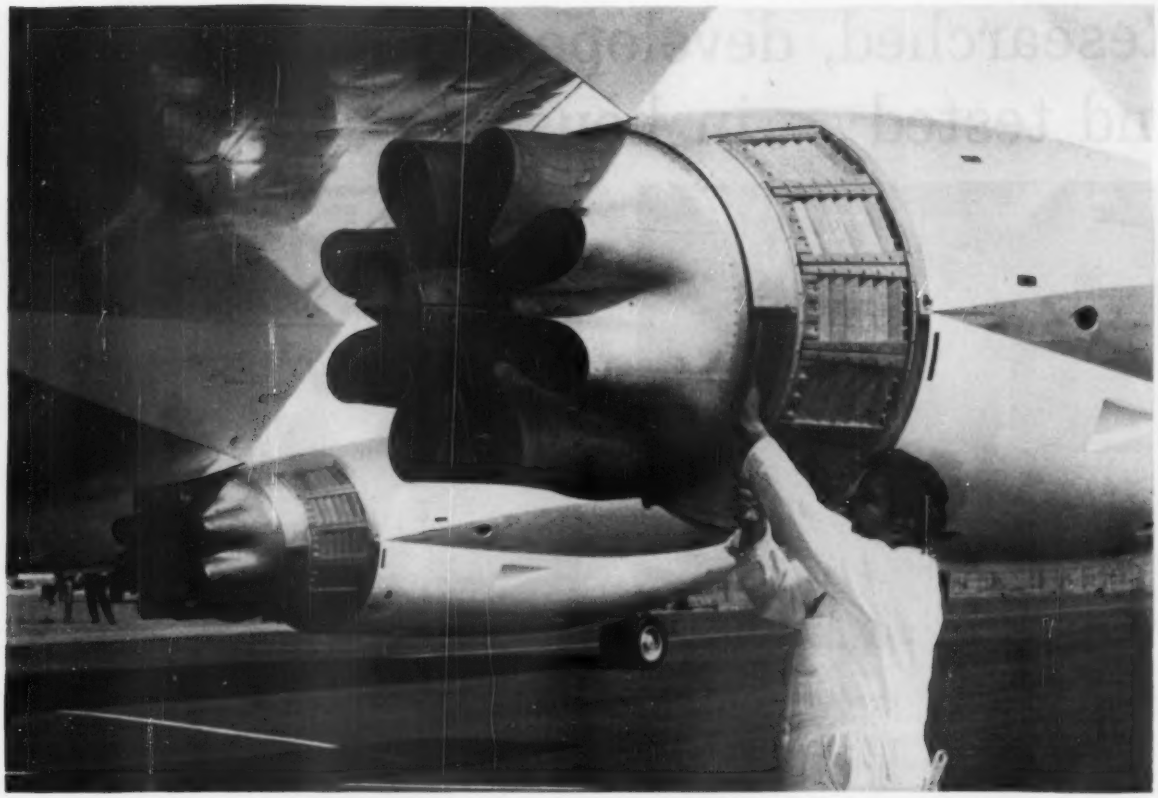


Made to Last – Sound-suppressor and thrust-reversal units for Convair 880 developed by General Electric and with critical parts made of HAPD's Inconel "W" nickel-chromium alloy. The daisy-ejector type suppressor is seen at rear of pod. Thrust-reversal vanes are just forward of the suppressor.

How Convair 880's sound-suppressor and thrust-reverser units resist heat, oxidation and corrosion

Three of the best reasons in the world led General Electric designers to choose a Huntington Alloy Products Division metal for vital parts in Convair 880's sound-suppressor and thrust-reversal units:

1. **Heat resistance** – HAPD nickel-chromium alloys have 1000-hour rupture strengths that go as high as 40,000 psi at dull red heat.

2. **Corrosion resistance** – HAPD nickel-chromium alloys show excellent resistance to oxidation and corrosion by jet-hot exhaust gases.

3. **Fabricability** – HAPD nickel-chromium alloys are readily fabricated. They can be cut, bent by many processes. What's more, welding can be done without reducing the metal's strength, without sapping its resistance to corrosion.

HAPD materials – among them such widely used alloys as Inconel*, Inconel "X"*, Inconel "W"* and Incoloy* – give a designer plenty of latitude. They meet exacting specifications. They're readily fabricated and welded by commonly used methods.

But perhaps even more important – almost anything you'd want to know about these versatile nickel-chromium alloys has been checked, reported, recorded and analyzed. As a result, our files are jam-jacked with useful information on many metal problems.

What's your design need? Are high temperatures a problem? Corrosion? Do you want more strength, less weight? One of Huntington Alloy Products' heat-resisting, corrosion-resisting nickel-chromium alloys may be just the material you've been looking for.

Your problem may already have been solved. So don't keep working on it alone. Write and get our advice and help. No obligation involved, of course.

*Inco trademark

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17, West Virginia

INCO TRADE MARK **ALLOY PRODUCTS**

TAPCO ELECTRICAL POWER COMPONENTS

TAPCO Group primary and auxiliary electrical power systems for space, missile, aircraft and ground power applications are tried and proven. Systems performed under environmental conditions including nuclear radiation, high-temperature, liquid metal vapor, zero-G and vacuum.

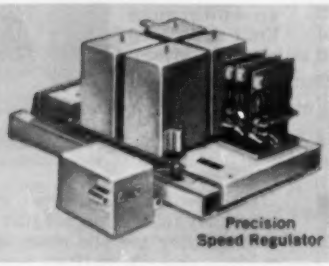
Below are typical TAPCO components now available for integration into systems for such applications. Other available TAPCO electrical power components include tachometer generators, speed sensors, high temperature electromagnets and solenoids, nuclear reactor rod drive controls, static inverters, voltage regulators and electronic power conversion devices.

ALTERNATORS

Among the special purpose rotating machines designed by TAPCO is a series of high temperature alternators. These range in capacity from a few watts to 15 kw at temperatures up to 1000°F.

PERFORMANCE DATA: TYPICAL ALTERNATOR—Power Rating: 3 kw, 0.8 pf lagging. **Ambient Temp.:** 700°F. max. **Operating Speed:** 40,000 rpm. **Output:** 115v, 2000 cps. **Inherent Voltage Regulation:** ±5%. **Harmonic Content:** 5% total. **Efficiency:** 85%. **Weight:** 9 lbs w/o shaft and bearings. **Size:** 3⅛" OD, 5⅛" long. **Special Conditions:** Operates in mercury vapor.

High Temperature
Permanent Magnet Alternator



Precision
Speed Regulator

VOLTAGE REGULATION AND SPEED CONTROLS

Associated with the TAPCO alternator and drive systems are system speed and voltage controls for extremely accurate frequency and voltage regulation. The unit shown is adaptable to many drive systems.

PERFORMANCE DATA: TYPICAL SPEED REGULATOR: Frequency Stability: 1 part in 100,000 integrated over minimum 1 hour period. **Input:** 115v, 400 cps. **Output:** 0-10v, 400 cps (phase reversing). **Feedback:** Valve position 0-57.5v, 400 cps. **Environmental Conditions:** −65 to +200°F, 50g shock for 11 millisec., vibration 0.1" double amplitude from 3 to 23 cps, 10g from 23 cps to 10 kc. **Weight:** 10 lbs. **Size:** 12" x 6" x 5".

LIQUID METAL PUMPS

A rotating permanent magnet driven by an external source induces pumping force in the liquid metal within a hermetically sealed system. This concept provides operation without friction-producing rotating seals and provides exceptional reliability and life.

PERFORMANCE DATA: TYPICAL ELECTROMAGNETIC PUMP—Fluid: Sodium. **Fluid Temperature:** 1000°F. **Capacity:** 30 lbs/min. **Driving Speed:** 40,000 rpm. **Pressure Rise:** 3 psi. **Weight:** 3 lbs. **Size:** 2¼" diam. flange bolt circle, ½" nominal pipe size.

Electromagnetic Sodium Pump

Tapco Group Export Representative:
American Avitron Inc. • Mamaroneck, N. Y.

Advanced engineering projects at TAPCO offer excellent career opportunities for qualified engineers and scientists. Write Personnel Director.

TRW

TAPCO GROUP
Thompson Ramo Wooldridge Inc.
DEPT. AW-2760 • CLEVELAND 17, OHIO

DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, MISSILE AND SPACE, ORDNANCE, ELECTRONIC AND NUCLEAR INDUSTRIES

How recent thread advances contribute to the development of higher fastener fatigue strength

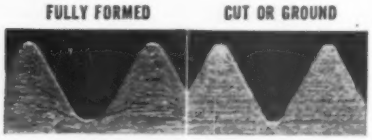
Fatigue and stress

It is a change in effective diameter that creates a stress riser, and with the threads, which consist of row upon row of notches, we have a really complex stress riser. No wonder, then, that 85% of bolt fatigue failures occur in the threads.

It would also be well to keep in mind that fatigue is a surface phenomenon and that we can increase the fatigue life of a bolt by reducing the stress concentration (a packing together of stresses) on any surface.

Fully formed threads

Threads, of course, can be made by different methods—cutting, grinding, rolling—each with a different fatigue life. In the macrophotograph shown here we note, in the right hand view, that the fibers of the material have been cut due to the



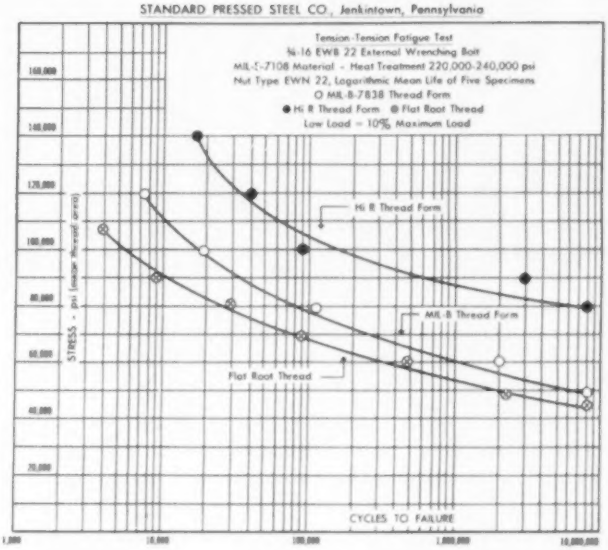
Metal is denser here

threading method. These cut fibers produce planes of weakness—create stress risers on the surface. The left view shows how the material has been made to follow the thread contour by rolling. The surface fibers of the material have been formed to follow the contour of the thread. This produces a much stronger, smoother thread. Fully formed threads, which are standard on all SPS bolts, thus add fatigue resistance to the most sensitive area of a fastener.

Thread rolling after heat treatment

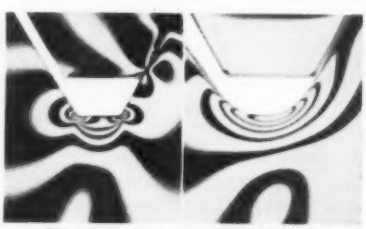
Fatigue life can be increased by inducing compressive stresses on a surface so that when a tensile load is applied, these compressive stresses are first reduced to zero, then changed to tensile stresses. The surface of the metal thus does not feel the total stress, but only the difference between that due to the applied load and the induced stress. This is precisely what we do—induce a negative stress—by cold working the threads *after* heat treatment.

Two lots of bolts were tested to determine how substantial would be the resultant fatigue life gain. The only difference in lots was that in one the threads were rolled prior to heat treatment and in the other *subsequent* to it. The endurance limit on the bolts with the cold-rolled threads was four times as great—80,000 as compared with 20,000 psi. Thus bolts subjected to dynamic loading should have threads rolled after heat treatment to obtain maximum fatigue resistance.


STANDARD PRESSED STEEL CO., Jenkintown, Pennsylvania
Tension-Tension Fatigue Test
¾-16 EWB 22 External Wrenching Bolt
MIL-S-7108 Material - Heat Treatment 220,000-240,000 psi
Nut Type EWN 22, Logarithmic Mean Life of Five Specimens
O MIL-S-7838 Thread Form
● Hi R Thread Form ⊕ Flat Root Thread
Low Load = 10% Maximum Load
STRESS - psi (Range Around Zero)
Hi R Thread Form
MIL-S Thread Form
Flat Root Thread
CYCLES TO FAILURE

Hi R thread

A fatigue crack usually starts on the surface at the thread root, with its sharp corners. So anything that could be done to make the thread root more resistant to fatigue would naturally increase the fatigue life of the fastener. The SPS Hi R thread root form does precisely that, because it is smoothly blended, radiused, and has an uninterrupted surface—all of which contributes to the effective distribution of stresses.



Shown here are photoelastic comparisons of flat root and Hi R root forms made at the SPS Laboratories for Advanced Fastener Research. Each black line represents a plane of equal stress . . . the more black lines, the more fatigue failure potential. The positions of the lines indicate stress distribution. With a flat root thread, stresses converge into hot spots at the sharp corners. The Hi R thread reduces stress in these spots to a minimum and distributes the remaining stress evenly.

Test results illustrated graphically above point up the gains in fatigue life provided by the Hi R thread. Note that the flat root thread has an endurance limit of *44,000* psi, the Mil-B-7838 thread form of *50,000* psi, and the Hi R of 80,000 psi.

SPS's 250,000 lb. Amsler fatigue testing machine—largest in America.

Implications

High-strength fasteners that are genuinely reliable do not just happen. Rather they are the result of painstaking and inventive design and development, precision fabricating techniques and machinery, and, of course, uncompromising testing.

What about the bolts you buy—bolts so critical to the success of aerospace projects? Will they really do the job? Evaluate your source of supply very, very carefully. Standard Pressed Steel Co. AIRCRAFT/MISSILE Division, SPS, JENKINTOWN 3, PENNSYLVANIA • SANTA ANA, CALIFORNIA.

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Miniaturized cavity-type filter packs 4.2 square inches of filtering area into 1" x 9/16" element

Purolator develops thumb-nail size element to protect hydraulic control circuits on Army's Hawk Missile mobile launcher.

How small can you make an element that must filter 2 gpm hydraulic oil at 2500 psi at any temperature within a 315° range? Purolator's new miniature cavity-type hydraulic filter is the best answer to date. Here's why:

4.2 square inches of convoluted stainless steel wire cloth are packed into this miniature filter. This element, which weighs 0.25 ounces, filters two gallons per minute of hydraulic oil, at temperatures ranging from —40° to + 275° F. The element will withstand 2500 psi differential pressure without collapsing.

The element is made up of a total of ⅛-mile of stainless steel wire, woven into wire cloth and convoluted to extend filtration area. This element will remove 98% of all particles whose two smallest dimensions are larger than 10 microns, and 100% of all particles measuring 25 microns or more.

The picture at the top of the page shows you the complete filter assembly, ready for installation in the hydraulic control system. The overall length of the unit is 2 1/32"; maximum overall diameter is 1". Total weight is slightly over 1 ounce. Designed as a cavity-type unit, the filter is installed simply by screwing it into the hydraulic system so the filter element intercepts oil flow. The element can be removed, cleaned and replaced without special tools.

The picture at right shows the mobile launching platform for the Hawk Missile. The compactness and mobility of the

launcher, and the probability that it would be subjected to severe jolting, made it necessary to specify as small a filter as possible, and one that could be integrated with the rest of the system for maximum simplicity and durability.

The Purolator engineers who developed this new miniature cavity-type filter are available now to design a filter to meet your specifications. Simply contact Purolator Products, Inc., Department 3096, Rahway, New Jersey.

Filtration for Every Known Fluid **PUROLATOR**

PRODUCTS, INC.

RAHWAY, NEW JERSEY, AND TORONTO, ONTARIO, CANADA

3M Materials Memo

News of materials for the aerospace industry... selected from the 27,000 products of the 3M Company

Where good contacts count

Good reliable connections are useful in any circles these days, but in electrical circuitry they're imperative. Of course, sometimes it's difficult to reconcile reliability with today's high speed fabrication techniques. Our ELECTRICAL PRODUCTS DIVISION has recently come up with a means of doing just that. It's the new "SCOTCHLOK" BRAND type UR connector. Although it's the functional equal of twist and solder jointing methods for communication cable, it's way out ahead on speed and convenience.

The whole secret lies in their unusual construction. They're made of a transparent thermoplastic material filled with silicone grease and use metal finger-like connector elements, built into a top closure button. The cut wires are inserted into the sleeve of the connector and the button closure is squeezed into the body of the unit, using a special crimping tool. Depressing the button removes the wire insulation, grips the conductors, insulates the joint, and provides a positive seal for the silicone grease. Thus, a complete splice is made in one operation, involving no stripping, twisting, soldering or insulating. And visual inspection of the joint speeds up quality control, too.

"SCOTCHLOK" UR connectors can handle any two or three wire combination of #19 to #26 AWG solid or #20 to #26 AWG stranded wire. They can be used virtually anywhere a splice is made and on nearly every type of wire used in the communications industry. This would include wires insulated with miscellaneous plastics, paper, enamel, rubber, Teflon, or other materials. Your local Electrical Products representative will be happy to show you how "SCOTCHLOK" connectors can literally put your operations on a push-button basis.

A case of non-support

A flame would have a tough time surviving if it had to depend on 3M's new printed circuit board construction. Designated as "CUCLAD" #6097, this newest member of a range of printed circuitry materials offers some really distinguishing (or perhaps we should say extinguishing) features. Containing special flame retardant additives in its laminated glass cloth-epoxy backing, this "CUCLAD" board offers a high degree of flame retardance without the usual brittleness. This means easy machining with little waste. In actual test, the flame extinguishes itself in one to two seconds after the torch is withdrawn.

No. 6097 includes qualification to Mil-P-18177B Type GEB and NEMA grade G-11; is available with one or two ounce electrolytic grade copper foil bonded to one or both sides. This bond offers a peel strength as high as 11 pounds per inch and is resistant to standard plating and etching solutions. What's more, it offers you the option to either standard dip or float solder the finished circuit. "CUCLAD" #6097, a versatile performer, is made more so by coming in a broad thickness range of from 1/64" to 2" in individual sheets, 36" x 42".

If printed circuitry is a burning issue with you, why not have your local MICA INSULATOR DIVISION representative give you more information on this exciting product—or fill in the coupon below.

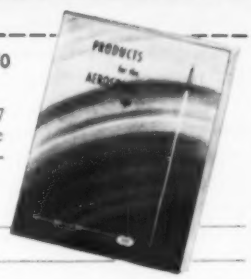
Need a megacycle memory?

Are the high frequency requirements in telemetry and radar signal recording proving to be fast company for your current equipment? Our MINCOM Division's new model CM-100 recorder-reproducer permits you to think big in terms of band width, but not cost. Not a one-track memory by any means, the CM-100 can pack 7 channels of data on a single ½" Scotch Brand magnetic tape. It literally permits you to stretch out these precious minutes of recording time by offering the capability of recording and reproducing greater band width at significantly slower speeds. For example, you enjoy 12 minutes of recording time in the one megacycle range running at 120 ips. You'll find that it pinches minutes for you like this at each of its 6 speeds. These speed variations, by the way, are available to you at the mere touch of a finger.

Our MINCOM Division proudly points to the fact that in addition to these virtues, the CM-100 represents somewhat of a first in versatility. It actually handles the work of two systems by storing both analog and pulse data with equal ease. This means that it's at home in practically any instrumentation application for telemetry or laboratory. For the full CM-100 story, contact your local MINCOM representative or clip the coupon.

3M Company, Missile Industry Liaison—Dept. VAC-70
St. Paul 6, Minn.

Please send more information on ☐ "CUCLAD" #6097 Printed Circuitry Material ☐ "SCOTCHLOK" BRAND type UR connectors ☐ "MINCOM" CM-100 Recorder-Reproducer ☐ 3M Products for the Aerospace Age.



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...WHERE RESEARCH IS THE KEY TO TOMORROW

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MISSILE INDUSTRY LIAISON

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Annealing: Its Uses with Alloy Steels

Broadly speaking, the primary purpose of annealing is to soften steel and make it more workable. Annealing, as applied to alloy steels, may be defined as a process that heats above, and furnace-cools through, the critical range at a controlled, specified rate of speed; or that heats to a point within, and furnace-cools to a point below, the critical range. In either case, the choice depends upon the structure and maximum hardness desired.

The first method produces a lamellar pearlitic structure, while the second creates a spheroidized condition. These will be discussed separately in the following paragraphs:

(1) *Lamellar pearlitic structure.* It should be mentioned at once that this structure can be obtained both as described above and by a modified method known as isothermal annealing. In the isothermal process, the steel is heated above the critical temperature (austenitized), then transformed at a predetermined temperature, which depends upon the analysis. This operation requires two furnaces or salt baths —one for austenitizing, one for transformation.

Lamellar pearlitic structures are generally associated with machinability in carbon ranges from 0.20 to 0.60 pct, provided the hardness does not exceed the optimum maximum Brinell numeral. This is especially true where critical tooling is involved. It is a very versatile structure, as it gives best results in such operations as broaching, tapping, threading, deep drilling, boring, milling, and tooling as applied on single- and multiple-spindle bar automatic machines.

(2) *Spheroidized structure.* There are two general fields of use for this type of structure when alloy steels are employed. In the low and medium carbon ranges, spheroidization is necessary for cold-shaping operations, such as heading, extruding, drawing. In the higher carbon ranges (over 0.60 pct), it is mandatory where machining is involved, because it tends to lower the hardness of the steel.

If you want more details about these and other uses of annealing, and the results to be expected, by all means consult with our technical staff. And when you need alloy steels, Bethlehem can offer the full range of AISI standard grades, as well as special-analysis steels and all carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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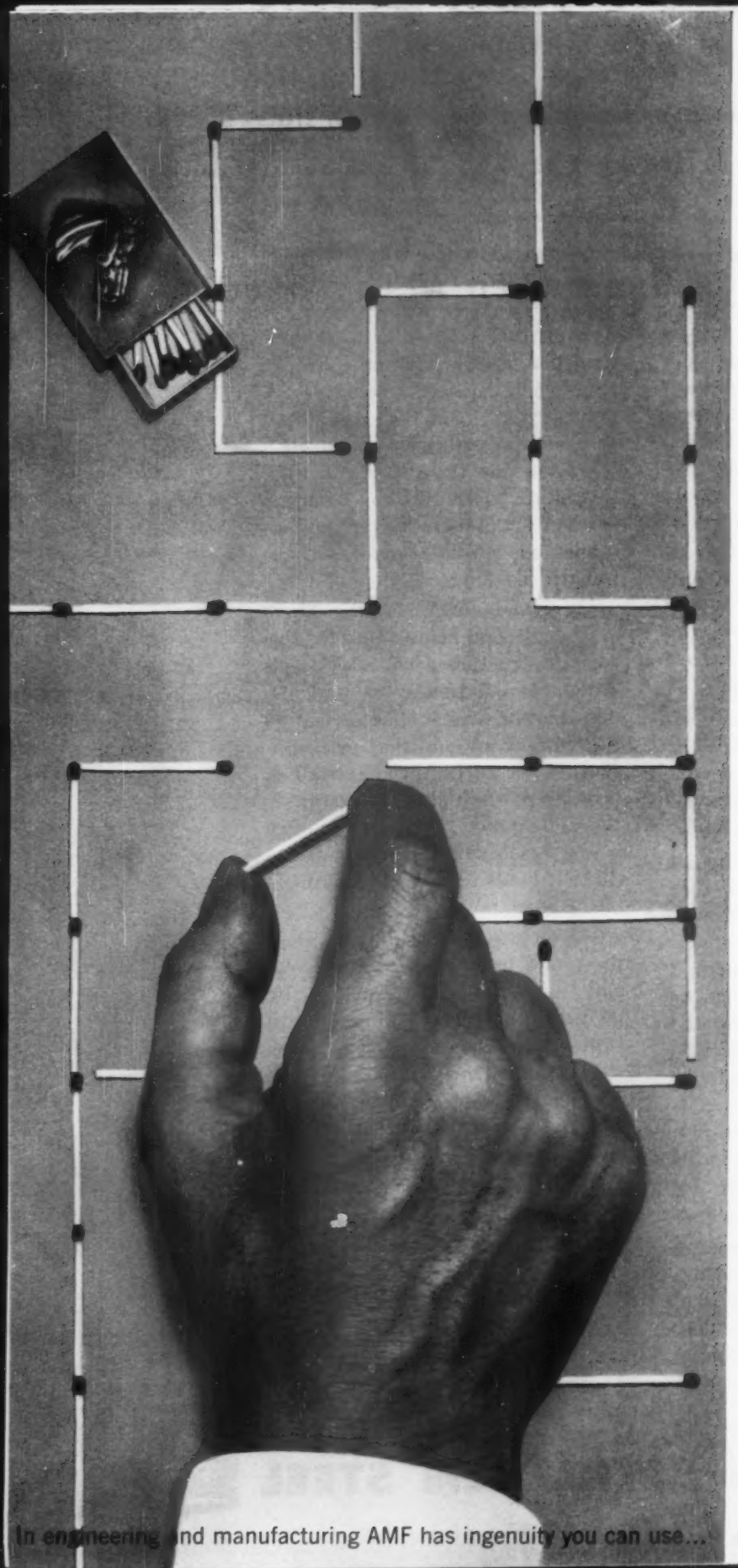
BETHLEHEM STEEL



He designed a new interchange for radio traffic

This AMF engineer, part of an AMF-U.S. Army team, solved the problem of traffic delays and personal danger in manual re-connection of jumpers when interchanging R.F. transmitters and antennas.

His solution is a push-button-operated, coaxial crossbar switching system, using vacuum switches for circuit selection. A typical system consists of 4 transmitter inputs, 7 antenna outputs plus a dummy load, in a 4x8 matrix that can be mounted in a 19" rack. It can be controlled locally or remotely over any type of communication network having a bandwidth of at least 200 cycles.

AMF's coaxial crossbar switching system provides 100% flexibility in circuit path selection and accommodates power levels as high as 500,000 watts and frequencies up to 30 megacycles. It allows 100% utilization of all transmitting equipment. Stubs are automatically eliminated.

To insure fail-safe operation, power is required for the vacuum switches *only* during change of condition. Selection rate: 1 per second. Operating transmitters are safety-interlocked to insure a load. There are no hazards from open wires or inadvertent application of power to dead-lined antennas.

Single Command Concept

AMF's imagination and skills are organized in a *single operational unit* offering a wide range of engineering and production capabilities. Its purpose: to accept assignments at any stage from concept through development, production, and service training...and to complete them faster...in

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July 18, 1960

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COVER: First Boeing 720 intermediate range jet transport for American Airlines, now being prepared for scheduled service, is tailored primarily for use over American's nonstop routes ranging up to 2,000 mph. The 720 is 8½ ft. shorter than the 707-120 transcontinental version used by American; gross weight is 221,000 lb., compared with 247,000 lb. for the 120. For other pictures, see p. 47.

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83,508 copies of this issue printed

When crews of SAC's 1st Missile Division successfully launched the USAF ICBM Atlas from Vandenberg Air Force Base, September 9, 1959, the world became aware that the United States had brought into being a formidable retaliatory power for peace. Within four months after the first operational launch, the Air Force doubly underlined this missile's capability. On a single day, January 26, 1960, the 16th and 17th consecutive successful Atlases were fired intercontinental ranges to predetermined targets from both Atlantic and Pacific bases.

After only five years of intensive development, including concurrent research, testing and fabrication under this nation's top military priority, Atlas is extremely versatile as well as powerful. It was the Project Score satellite vehicle and is scheduled for use in Project Mercury, the Man in Space Program, and in other space exploration missions. Thus, used as a booster for space projects, Atlas provides the nation with a key capability in scientific as well as military applications.

Space Technology Laboratories provides the systems engineering and technical direction for the Atlas as well as other portions of the Air Force Ballistic Missile Program. Much of what was learned in building Atlas has helped cut the lead-time in the development of such other Air Force Ballistic Missiles as Thor, Titan and Minuteman.

Among the industrial organizations which have worked in concert in developing Atlas are such major contractors as: Convair, Division of General Dynamics Corp. for airframe, assembly and test; General Electric Co. and Burroughs Corp. for radio guidance; Arma, Division of American Bosch and Arma Corp. for inertial guidance; Rocketdyne Division of North American Aviation, Inc., for propulsion; General Electric Co. for re-entry vehicle; Acoustica Associates for propellant utilization.

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ATLAS

The continuing development of Atlas as well as other USAF missiles and related space probes, has created important positions on STL's technical staff for scientists and engineers with outstanding capabilities in: thermodynamics, aerodynamics, electronics, propulsion systems, structures, physics, computer technology, telemetry, and instrumentation. If you believe you can contribute in these or related fields and disciplines, you are invited to send your resume to:

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EDITORIAL

Missile Blackmail

Events of the past week following the U-2 episode and the Paris summit conference should shock every American into realizing the bold, ugly outlines of the Communist threat to our immediate future. Even the most pessimistic analyst of the international situation, and we have found little cause for optimism in recent years, would hardly have dared to predict the sequence or the magnitude of the disasters this country has suffered in its international relations.

Perhaps the combination of Nikita Khrushchev's arrogant "burying" of the Monroe Doctrine, his threat to intervene in the Western Hemisphere through Cuba, and the cynical assassination of a USAF RB-47 electronic reconnaissance plane in international airspace should finally enable the American people to see the spots on the leopard leaping at their throats and at long last arouse our complacent leadership to the fact that there are more important events occurring than another round of golf.

Behind this series of shocking events and the others that are sure to follow in this dismal summer lies the fundamental fact that either through intent or stupidity our national leaders have permitted a significant disparity to develop in the key elements of military power between this country and the USSR. The missile gap of the 1960s was predicted in great detail by both military leaders and knowledgeable civilians. Its consequences were outlined with accuracy that is now being confirmed by events. Unfortunately this country chose to believe those who dismissed the missile gap as a figment of munitions makers' imaginations. In the final few years of the Fifties that remained for significant decisions, we did little to ensure our survival during these perilous years of the Sixties. We are now in the midst of the missile gap. Its consequences are readily apparent. We are being subjected to the most brutal sort of international blackmail—missile blackmail.

Mr. Khrushchev believes he has sufficient ICBMs to make effective his threats to blast any adversary with nuclear-tipped rockets on a wide variety of provocations ranging from the use of foreign bases by U. S. planes to the defense of U. S. bases in the Western Hemisphere from local aggression. To demonstrate the technical ability of his ICBMs, he has staged a series of test firings into a mid-Pacific impact area where we have ample technical instrumentation to measure their performance in great detail.

At the same time Mr. Khrushchev has been demonstrating his ICBM capability, the USSR has been engaged in a crash program to enlarge and improve its air defense system. During the past two years new supersonic fighters with auxiliary rocket power boost, new types of radar with greater altitude capability and new types of anti-aircraft missiles have appeared in significant quantity increases in the Soviet air defense system.

It is meaningful that somebody in the USSR ordered the destruction of the USAF RB-47 even though it was still in international airspace. After the embarrassment of the U-2 penetrations the USSR badly needed a convincing public demonstration of its air defense capability just as it staged the Pacific missile shots to prove its competence in the ICBM field. In his press conference Mr. Khrushchev went into considerable and reasonably accurate detail on the technical performance of the B-47 and pointed out that this type is the largest element in our strategic bomber fleet. Then he used the destruction of the RB-47 by Soviet fighters to make a point that U. S. strategic bomber strategy is as obsolete as the B-47 on which it depends.

Thus Mr. Khrushchev has publicly established the two vital elements he needs to practice missile blackmail on the United States and its allies—a verifiable ICBM capability with acceptable accuracy over 8,000 mi. ranges and an air defense system designed to prevent the bulk of SAC's manned bomber fleet from penetrating the Soviet Union on a retaliatory mission.

These are weapons that, properly applied, would pull the rug from under Mr. Khrushchev's carefully constructed missile blackmail techniques. A counter-ICBM force of effective size dispersed and hardened would nullify his current air defense system. Equipment of the SAC bomber fleet with the Hound Dog air-to-ground missile would also make a mockery of this air defense system by searing great penetration corridors long before either fighters or anti-aircraft missiles could reach the attacking bombers. A B-52 fleet equipped with Hound Dogs and supported by sufficient jet tankers and other equipment to maintain an airborne alert would trump most of the cards in Mr. Khrushchev's current military hand.

However, these vital elements do not exist today in the operational arsenal of Strategic Air Command. Regardless of what rosy impressions have been created by Administration leaders' speeches, none of these weapons are in operational use today. They won't be for some months and in some cases for years to come. What have we done to accelerate the production and equipment of our strategic forces with these weapons? Precious little! They have all been proceeding at a relatively leisurely pace, dictated primarily by fiscal, not military, considerations—a pace based on the premise that no real Soviet military-technical threat exists.

Our failure to provide SAC with the air-to-ground penetration missiles and augmented B-52 and jet tanker fleet, the supersonic B-58, and a truly significantly sized and timed Atlas and Titan program—all as fast as possible—is costing and will cost us far more in terms of this country's future than the monetary price of these measures, no matter how slipshod their fiscal management might have been.

Nor will the USSR stop with missile blackmail. If and when we make the necessary effort to boost our strategic forces into competitive parity or superiority, we can expect the Soviets to move their blackmail technique into a new technical area—outer space. Satellite blackmail is certainly next on the Soviet timetable if and when its missile blackmail becomes technically and diplomatically obsolete.

President Eisenhower has warned the Soviet Union that continuation of its current policies toward this country will result in "serious consequences." Every American will look forward to the emergence of United States policy designed to stop missile blackmail and the cynical slaughter of American air crews in international airspace.

—Robert Hotz

SPECIAL DESIGN

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Retriever service — This new Cornelius compressor assembly, Model 3800209, is invaluable for retrieving "downed" aircraft. It is easily flown to any location to provide complete pneumatic service for aircraft of all types.

Military Identification for Model 3800209 — Federal Stock No. 4310-585-8240, Type ACU-2/M, Index No. 0157-2160, meets military specification MIL-C-25989 (USAF).

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This new Cornelius pneumatic system is exceptionally small in size but it is capable of providing all the basic functions of much larger and heavier ground support compressor assemblies. It does the work of much larger units at far less initial cost and at lower operation, transporting, storing and shipping costs. Here are 3 good reasons why this system greatly improves the flight line service of airlines and air wings everywhere.

1.) The complete assembly measures only 9.5 cu. ft. (30" x 20" x 27"). Weight: less than 250 pounds. Ideal equipment for airlift operations and retriever service anywhere in the world. One man can easily roll the complete equipment from one location to another. Two men can easily load it into any vehicle.

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3.) This assembly can be used to service accumulators, actuators, pneumatic system reservoirs, tires, struts, and other miscellaneous pneumatic gear. It provides clean, dry air at regulated pressures to 3000 psi and at volumes of up to 4 cfm free air.

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WHO'S WHERE

In the Front Office

Bell Aerospace Corp., Buffalo, N. Y., a subsidiary of Textron, Inc., has announced the following as officers of the new corporation's three divisional companies. Bell Aerosystems: **William G. Gisel**, president; **Dr. Walter R. Dornberger, James E. Davis, John A. von Lonkhuyzen** and **Peter J. Wacks**, vice presidents; **Norton C. Willcox**, vice president and controller. Bell Helicopter: **Edwin J. Ducayet**, president; **James F. Atkins**, executive vice president; **Roy Coleman, G. B. Clark** and **Bartram Kelley**, vice presidents; **Theodore R. Treff**, treasurer. Hydraulic Research and Manufacturing: **Carroll M. Martenson**, president; **Stuart A. Baker**, vice president and controller.

Dr. Charles J. Kensler, vice president in charge of the newly established Life Sciences Division of Arthur D. Little, Inc., Cambridge, Mass.

Dr. Arch C. Scurlock, a director, C-E-I-R, Inc., Arlington, Va. Dr. Scurlock is cofounder and president of Atlantic Research Corp.

Ray O. Ryan, president and a director, Summers Gyroscope Co., Santa Monica.

Theodore Grant, vice president and Western office manager, Aerospace Industries Assn., succeeding **Capt. Leland D. Webb** (USN, ret.), retiring.

H. Fletcher Brown, vice president and assistant to the president of Lockheed Aircraft Service and Lockheed Aircraft Service-New York, with offices in Ontario, Calif.

John P. Gaty, retiring as vice president and general manager of Beech Aircraft Corp., Wichita, Kan., to devote more time to personal interests.

Brig. Gen. Francis C. Gideon, director of Air Materiel Command's new Data Systems Directorate, and **Col. Howard B. Seim, Jr.**, deputy director.

Joseph A. Stein, deputy director of public information, National Aeronautics and Space Administration, replacing **Herbert H. Rosen** now a deputy in the new NASA office of technical information and education.

Honors and Elections

Dr. Theodore von Karman, chairman of NATO's Advisory Group on Aeronautical Research and Development, has received the American Society for Engineering Education's Lamme Medal for distinguished contributions to engineering education and research. Other ASEE awards: **Dr. Maurice J. Zucrow**, Atkins Professor of Engineering at Purdue University, the Vincent Bendix Award for ". . . exploitation of basic research in the field of jet propulsion . . ."; **Dr. Robert B. Bird**, professor of chemical engineering at the University of Wisconsin, the George Westinghouse Award for ". . . introducing basic science into engineering education."; **Dr. Ali B. Cambel**, chairman of the Mechanical Engineering Department at Northwestern University, the Curtis W. McGraw Award for originating new concepts and methods in a research program in aerothermochemistry, magnetohydrodynamics and plasma physics.

(*Continued on page 146*)

INDUSTRY OBSERVER

► Bid requests are scheduled to be issued next month by National Aeronautics and Space Administration for system components for the Nimbus meteorological satellite. Nimbus, still two to three years from operational status, is projected to have two 800-line, improved resolution vidicon cameras, one of which will be capable of being aimed by ground control. Cameras may be tried initially in Tiros II. Tiros I carried 500-line vidicon cameras.

► **Soviet scientific research ship Yu. M. Shokalsky, equipped to launch meteorological rockets, has made its first firing run in the Black Sea. Rockets are carried in a hold beneath the forward deck. Instrumented nose section is attached before the rocket is raised through a special hatch. Ship can remain at sea 120 days.**

► Proposals are being submitted to NASA by major rocket engine manufacturers in competition for a study contract leading to large solid propellant boosters of at least one million pounds of thrust. Contract award is expected within a month.

► **Both NASA and Air Force are investigating the possibilities of reverse flow nozzles for liquid and solid propellant rocket engines. Liquid reverse flow engine would use an annular nozzle, have a flow chamber only one-fourth to one-third the length of a conventional bell nozzle delivering the same thrust. Principle is of interest mainly for application to very large engines, where engine length is great enough that the saving is considerable.**

► Lockheed Aircraft Corp. has tested more than 30 small scale models of high-speed vehicles from Mach 2 to Mach 18 in tunnels at the Von Karman Gas Dynamics Facility and Arnold Engineering Development Center. Tests, done under USAF contract, are expected to corroborate a theoretical study of the aerodynamics of such vehicles, and to lead to development of a design manual for winged hypersonic glide vehicles.

► **Mating of Redstone booster and McDonnell capsule for the first suborbital Redstone flight in Project Mercury is under way at Marshall Space Flight Center. Booster has an extended tankage and instrument compartment similar to Jupiter-C space booster and uses the more powerful Rocketdyne A-7 Redstone tactical engine, which delivers 78,000 lb. thrust. Vehicle will have a control system but no guidance system, since shots require only simple ballistic trajectories.**

► Air-Craft Marine Engineering has proposed to Army an amphibian cargo aircraft weighing about 30,000 lb. and powered by four 1,500-lb.-thrust turbofan engines. It would have a swing tail hinged at the top. Joint would be at a 45-deg. angle, allowing loading from above as cargo could be taken on from ship at sea. Range of 3,000-3,200 mi. would allow it to carry cargo from a freighter at sea to a point some 1,500 mi. inland.

► **Soviet scientists have described efforts to disperse clouds and fog by means of powerful sound generators as partially successful. Experiments were carried out on a mountain slope under natural conditions.**

► Increased emphasis on development of beryllium as a structural metal has been recommended by NASA's Research Advisory Committee on Structural Design. Development cost appears to be warranted by weight gains that beryllium would offer on third-generation space vehicles, which are expected to have a much larger internal volume than the Mercury capsule and its follow-on vehicle.

► **Ukrainian Academy of Sciences will establish a Physio-Technical Institute of Low Temperatures to do research in low-temperature electronics, magnetism, resonance phenomena in solids, electroconductivity and superconductivity, plasticity and strength of solids and thermodynamic properties of liquefied gases.**

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2N1119	Switch	f_T-7.2 mc	electrical equivalent of 2N496, TO-5 case
2N1426	Amplifier, Switch, Control	f_{max}-18 mc	low cost, high beta, TO-1 case
2N1429	Amplifier, Switch, Control	f_{max}-18 mc	low cost, high beta, TO-5 case

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2N1268	Med. Frequency Amplifier	f_{max}-43 mc	medium beta
2N1269	Med. Frequency Amplifier	f_{max}-43 mc	high beta
2N1270	High Frequency Amplifier	f_{max}-125 mc	low beta (video amplifier)
2N1271	High Frequency Amplifier	f_{max}-125 mc	medium beta
2N1272	High Frequency Amplifier	f_{max}-125 mc	high beta
2N1472	Switch	f_T-75 mc	very low V saturation superior temperature stability
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Washington Roundup

ARPA Shuffle

Under latest Pentagon organization change the Advanced Research Projects Division of the Institute for Defense Analyses (IDA) will now provide technical support directly to office of Dr. Herbert York, director of defense research and engineering, instead of only to Advanced Research Projects Agency as prevously. Division is now called Research and Engineering Support Group, with William Bradley as acting director. The shift is another move which suggests that ARPA and its functions are gradually being absorbed directly into Dr. York's organization.

Administration still has not indicated how much it will spend from the extra $700 million in defense funds voted by Congress above President Eisenhower's requests. But Defense Secretary Thomas S. Gates, Jr., now says he is "sure that we would want to use some of them to expedite some of the weapon systems we have on the way."

There have been signs that the Budget Bureau might not release the extra funds, and it is certain that the bureau would like to see as little of the $700 million spent as possible.

What Defense plans to do is to take the extra money into account as it plans its Fiscal 1962 budget—asking a little less than it would have if Congress hadn't added the new money.

Gates points out that the increase was only about 1.5%, and says that "verifies the position that the Administration has taken that this is an adequate defense [budget] and appropriate to secure our national posture over the years ahead."

Although New York Gov. Nelson Rockefeller wants the nation to spend another $3 billion for immediate defense needs, Gates says there's no difference between Rockefeller and himself in the fact that they both believe "we should be strong and we should lead from strength in all our foreign policy problems." As for the $3 billion difference, the question of size of the budget is a matter of judgment, Gates said.

On the questions of U. S. military bases abroad, Gates believes that the nation now is doing a good job of maintaining alliances and friendships in spite of what he called "troubles that break out because of well organized minorities."

U-2 Flights

Despite official reassurances here that no Lockheed U-2 reconnaissance aircraft are flying outside the Western Hemisphere, Moscow continues to tell Arab nations by radio that U-2 spy flights in the Middle East are still going on.

Most recent Russian broadcast used the device of quoting Greek and Egyptian newspaper reports. The Greek paper said "the American 10-10 air detachment is now completely devoted to carrying out espionage activities against Arab countries. For this purpose American aircraft use the military bases in Turkey, Libya and Saudi Arabia."

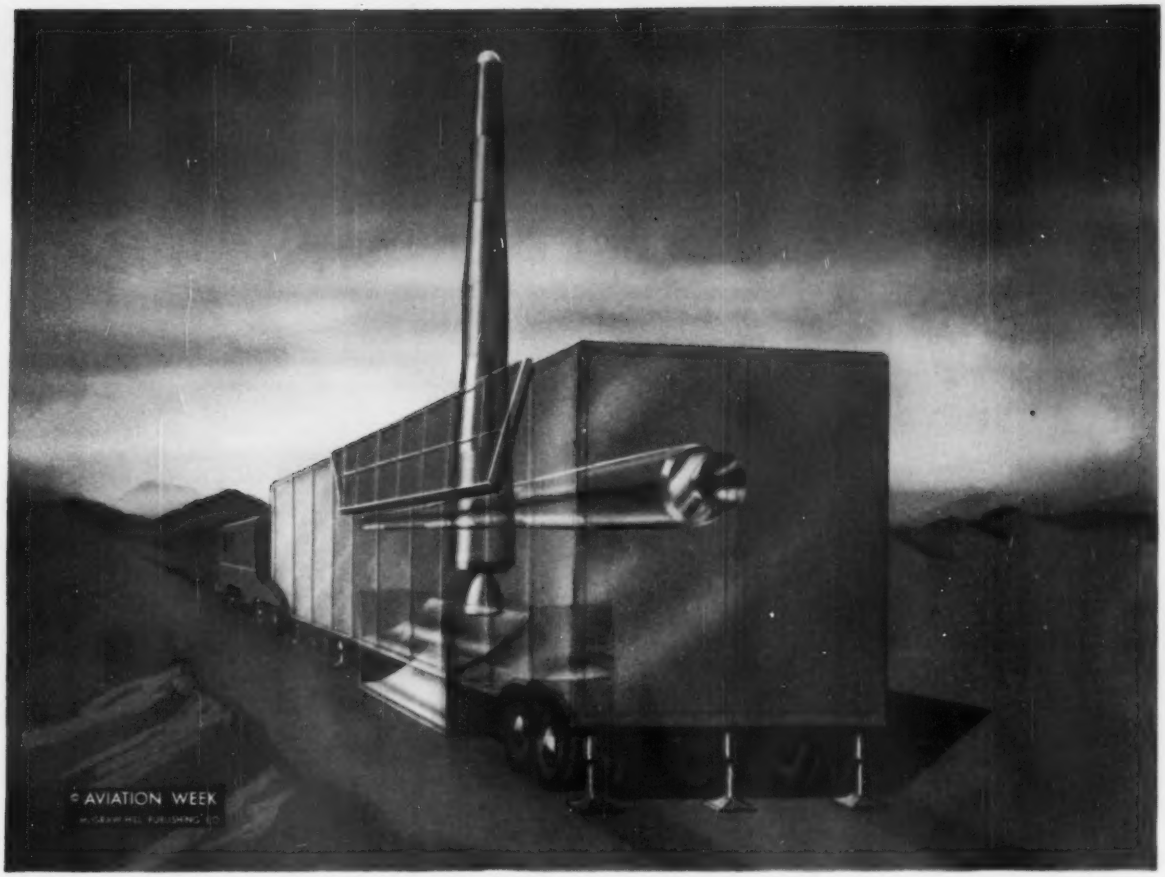
A Cairo weekly said that four U-2s had carried out regular spying flights over North Africa during May. Russian broadcasts make the point that the flights go on in spite of Soviet warnings and even though President Eisenhower said they had been stopped. The radio reports end with a long Communist commercial against the use of foreign bases by the U.S.

Russia also continues to insist that U-2s are based near the city of Alice Springs in central Australia. They say Prime Minister Menzies has said that the base is used only for meteorological observation, but charge that in the Washington vocabulary, meteorological is synonymous with espionage.

Space APU

Air Force Scientific Advisory Board has formed a new committee on non-propulsion space power to provide technical guidance both to USAF's chief of staff and to the Director of Defense Research and Engineering. The group will survey state of the art and Defense Department programs in space power energy conversion and make recommendations for improvements where required. The committee co-chairmen are Dr. Arthur Biehl, University of California, and Dr. E. E. Plesset, who heads E. H. Plesset Associates.

Senate Preparedness Investigating Subcommittee has concluded that successful development of a manned weapon system such as the North American B-70 Mach 3 bomber could advance development of a supersonic transport and would be an important step in the progress of controlled flight. This supports an earlier statement by the House Committee on Science and Astronautics that the future of a U.S. supersonic airliner is closely linked to the B-70 program (AW July 4, p. 38). House group urged National Aeronautics and Space Administration to assume a leading role and produce a definite plan for developing a U.S. supersonic transport. **—Washington Staff**



ARTIST conception of third-generation intercontinental ballistic missile mobile deployment shows trailer transporter-launcher which would elevate small lightweight projectile for firing from the trailer at any location during its regional travel. Trailer would be expendable.

USAF Sees Small ICBM as Future Weapon

Lightweight missile would halve Minuteman's weight, cost; system will be Aerospace Corp.'s first project.

Washington—A third-generation intercontinental ballistic missile system, with critical requirements of small size, motor truck mobility and low production and operational costs, is being projected by Air Research and Development Command's Ballistic Missile Division to cover state-of-the-art technology envisioned for jumps of approximately five and 10 years from today.

Advancement of the program would be one of the first prime jobs of Aerospace Corp., new civilian nonprofit advance-planning and systems management arm of the Ballistic Missile Division.

Designated System Study Requirement (SSR) 7790-19782, the small ICBM project might involve an expenditure of at least $1.5 billion for the research and development phase preceding operational capability.

The missile portion of the system, informally referred to in industry as Midgetman or Shrimp, represents the direct opposite of earlier military thinking, now abandoned, for deploying a huge ballistic missile with a large warhead, greater in size than the first-generation Atlas and Titan ICBMs.

Mobility of the small ICBM would exceed that projected for railway-car deployment of the second generation Minuteman ICBM, now under development, probably would weigh one-third to one-half of Minuteman's mass, embody an equivalent strategic capability for perhaps half the cost.

The Ballistic Missile Division has established only key basic parameters for the small, lightweight ICBM system, looking to industry members to supply untried but plausible approaches.

Briefing for industry was made at the Ballistic Missile Division, Inglewood, Calif., on May 19. Approximately 35 industry members attended, including Boeing, Douglas, North American, Northrop, Convair, Lockheed's California Division, Ford Motor Co.'s Aeronutronic Division, Aerojet-General, Thiokol Chemical Corp., United Technology Corp., Grand Central Rocket Co., and National Engineering Science Co.

Mixed Reaction

Reaction to a request for unfunded study proposals was mixed, with some companies enthusiastic, others expressing indifference.

Some industry members previously had submitted voluntary proposals for third-generation ICBM programs to the military.

Some companies already participating in the ballistic missile program were considered to have an advantage because of having been able to apply a certain percentage of contract funds for prod-

uct improvement which conceivably could have been directed to a third-generation ballistic missile.

Highlights of the projected study:

• **Briefing by BMD** anticipated that all industry members desiring to participate in the unfunded studies for the third-generation ballistic missile would file letters of intent by June 1.

• **First phase** of the unfunded studies would cover third-generation ballistic missile concepts substantially within the state-of-the-art, with 1965-1967 as an operational goal. Submission date for first phase unfunded proposals tentatively is set for Sept. 1, 1960.

• **Second phase** of the unfunded study relates to a future "exotic" state-of-the-art, capable of being translated into feasible hardware by 1970. Submission date for these proposals is March, 1961.

Contractor selection, but more likely advanced studies or formal requests for proposals, presumably would be considered after the unfunded proposals were evaluated.

While broad proposals for characteristics of the system generally are being left to industry, key requirements indicated as necessary for the small, lightweight ICBM are considered relatively critical. Feeling among some of the industry participants at the briefing was that the military "was asking a lot."

System Requirements

Considering state-of-the-art advances, the third-generation small ICBM system probably would be projected around general requirements such as the following:

• **ICBM range** would span distances from 2,500 mi. to 8,000 mi.

• **Targeting capability** could involve a a circular error probability (CEP) "almost on the nose," with an outside limit probably not exceeding one-quarter mile.

• **Guidance package,** which probably would have to embody terminal guidance capability, would be restricted in weight, likely not exceeding 50 lb.

• **Payload capability** might be in the range of 200 lb. to 600 lb.

• **Long-time storable solid** or liquid propellants will be required, with a specific impulse in the region of 300 at sea level. This will impose a requirement for radical advancement in propellant technology, particularly in the solid propellant field, where outlook for specific impulse is in the region of 160 attainable in increments in the next year or so, followed by a relatively low incremental increase thereafter. Relatively high specific impulses for solids could be attained without too great an effort, but attaining these values with a practical propellant from the standpoint of safety is not easily achievable. Likelihood is that formulation of solid propellants with high specific impulses would bring the effort under the "exotic" state-of-the-art.

Hybrid propulsion systems will be studied for the application, with the liquid propellant, in effect, acting as the catalyst for the solid medium, with the proportion of liquid to solid material being relatively small.

Liquid propellants probably will be required to be non-cryogenic and hypergolic, or monopropellants.

• **High mobility-capability** for relative invulnerability will involve a motor truck trailer combination transporter-launcher—probably a van-type vehicle with cushioning characteristics to make it compatible with a wide range of terrain.

The vehicle would incorporate a mechanism to elevate the missile into firing position, and provide sufficient "pad" stability for launch. The motor truck hauler, containing launch control equipment, probably would separate from the van to provide safe separation distance at firing.

For sufficient retaliatory capability after withstanding enemy attack, probably in excess of 20,000 transporter-launcher trucks would be deployed in a nation-wide operational scheme for firing from any location. It's likely that economics would dictate that the transporter-launcher be destroyed at firing of the missile, rather than design the truck launching scheme to permit salvaging.

Total weight of one of these loaded vehicles probably would be 40,000 lb.-45,000 lb., with about 20,000 lb. being allocated to an optimum small, lightweight missile being hauled.

Truck manufacturers, reported to be anticipating the requirement, already are engaged in projecting transporter-launcher designs.

UAW Signs at United Aircraft Plant

First major break in a long and bitter strike at United Aircraft's Connecticut plants came last week when United Auto Workers union signed a new contract at Pratt & Whitney Division's North Haven plant and accepted the firing of seven workers involved in incidents of violence.

United's position is that it retains the right to discharge workers involved in incidents ranging from tire slashing and picket line violence, to throwing of "paint bombs." The North Haven meeting was attended by delegations from Sikorsky and Hamilton Standard divisions but there were no incidents.

Negotiations with bargaining units at those two plants remain at a standstill and no meetings are scheduled. The North Haven contract involves only improved seniority clauses; a 7-12 cents per hour increase was given some time ago and wages have not been an issue. United remained firm on demands for full arbitration, automatic wage raises and compulsory union membership. Company has 80% of its force working.

At Boeing Airplane Co. the International Association of Machinists is studying a package offer of 17 cents an hour in wage raises and fringe benefits.

Significant agreement, involving a three-year contract with no wage re-openers for that period, was reached by Bell Helicopter Corp., Hurst, Tex., and United Auto Workers production and office workers locals, after a series of federal mediation sessions.

In addition to the clause eliminating re-openers, the contract contains a wage increase for the first year, a 7½ cent per hour increase the second year, and seven cents in the third year. Originally, negotiations had started on reopener clauses of a contract which had 10 months to run. It was this contract that was scrapped for the new pact.

Bell also will provide a new pension plan, fully-paid by the company, for hourly employees.

Lockheed's Georgia Division at Marietta last week signed a two-year contract with the International Association of Machinists, calling for incorporation of the present six cent cost of living bonus to base wages and continuing the cost of living bonus for the two-year period. Workers will get a seven cent hourly wage increase on July 10, 1961. Benefits include layoff payments of $50 for each full year of service, up to $500 for 10 years, and vacation and insurance improvements.

Elsewhere at Lockheed, negotiations continued with no immediate sign of success, as of late last week. Lockheed Missiles and Space Division talks with the IAM still were centered on the issue of job reclassification, and the California Division's offer is under study by the union. This calls for a four cent hourly wage increase this year, retroactive to June 13, plus incorporation of the six cent cost of living bonus. Proposal also includes a three cent an hour wage raise next year, severance pay provisions, continuance of cost of living pay and improved group insurance.

At Ft. Worth, Tex., Convair Division of General Dynamics Corp. reached settlement with the Federated Independent Texas Union, representing about 400 workers who will receive a four cent hourly increase, retroactive to June 6. In the second year of two-year pact, the workers will get an additional three cents, plus fringe benefits.

Negotiations still are under way between Convair-Ft. Worth and the IAM, bargaining unit for about 9,500 workers.

RB-47 Leads to Exchange of Warnings

Washington—Shooting down of a USAF RB-47 reconnaissance bomber by Soviet Russia over the Barents Sea on July 1 produced a warning from Russia last week that the U.S. and its allies are "provoking serious military conflict" by continuing espionage flights, and a counterwarning by the U.S. that repetition of such "unjustified action" as the "wanton attack" on the plane (AW July 11, p. 32) over international waters will have "the most serious consequences."

Russia announced on July 11 that a Soviet fighter had shot down the Strategic Air Command aircraft 13.67 mi. from Svyatoy Nos (Holy Nose) Cape after its first signals requesting the RB-47 to land were ignored.

Russia said it had captured the copilot and navigator and would try them under "full severity of Soviet law," and said it had found the body of the pilot in a life raft. It did not account for three other crew members except to say that they were trained in photo and electronic reconnaissance.

In a strong note of protest to the U.S. and in statements by Premier Nikita Khrushchev, Russia linked the flight to espionage flights of the Lockheed U-2 and laid heavy emphasis on the recent Russian theme that the U.S. is using foreign bases for "provocative" flights that violate Soviet territory.

Khrushchev said his government waited 10 days to reveal what had happened "to see how the American side would explain the disappearance of the plane. . . . We had trapped them on May 1 [when Russia downed a U-2 near Sverdlovsk] and we wanted to trap them again on July 1. And to a degree we succeeded."

The U.S. announced shortly after the plane disappeared that it had taken off from Brize Norton airfield in England on an "electromagnetic research" flight to survey the earth's magnetic field as an aid to map making.

The plane's position was last reported as 275 mi. north of Russia's Kola Peninsula and 275 mi. west of the Russian island of Novaya Zemyla, and there was no deliberate violation of Soviet territory, the U.S. said. A week's search was operated unsuccessfully from the airfield at Bodo in northern Norway, the same base which Russia said was to be the terminal point for the May 1 flight of the U-2.

Russia protested to the U.S., England and Norway. The Soviet note indicated that Defense Minister Marshal Rodion Malinovsky had not carried out his much publicized orders to retaliate with rockets against overseas bases of U.S. aircraft that violated Russia's borders because the intrusion "was stopped in its early stages." Asked how to understand this, Khrushchev said:

"I can only repeat: understand it the way Marshal Malinovsky has stated. When and how the warning will be put into effect—on this score the Defense Minister has been given fairly precise instructions. He in turn has given instructions to the rocket forces."

Khrushchev addressed 300 correspondents at a press conference in Moscow. ". . . The plane was shot down by our fighter plane," he said. "Should any more of them follow its course, they would end up in the same way and the unwelcome guests invading this country would find their graves here."

If flights over Russia by U-2s are resumed from overseas bases with permission of the countries involved, as some sources have speculated might happen, the U.S. "would deliberately act so as to raise tensions to a point where a war may break out," Khrushchev said.

The U.S. insisted in a strong reply to Russia that the aircraft was never "closer to Soviet land territory than about 30 mi." The protest note said "it is therefore evident that pursuant to instructions of the Soviet government, airplanes of the Soviet air force wantonly attacked the American airplane over international waters."

The note used the plural in referring to "airplanes of the Soviet air force," although Russia had mentioned only one fighter. Russia decorated the fighter pilot, Capt. Vasily Polyakov, with the Order of the Red Banner. Fighter apparently was a two-man aircraft, because Sr. Lt. Anatoliy Kotlyarov, identified as navigation officer, was cited for his accuracy and referred to as a flyer.

The U.S. protested that the RB-47's flight was "entirely different in character" from the U-2 flights, and said:

"The Air Force flight on July 1 was one of a continuous series of electromagnetic research flights well known to the Soviet government to have taken place over a period of more than 10 years. Instructions to the crews rigidly require that the aircraft remain well outside the airspace of Soviet territory."

The U.S. demanded release of the copilot, 1st Lt. Freeman B. Olmstead, and the navigator, 1st Lt. John R. McKone—something it did not do in the case of U-2 pilot Francis G. Powers—and demanded that a U.S. representative be allowed to "see these men without delay." It also demanded return of the body of the pilot, Capt. William A. Palm.

The U.S. note "solemnly and vigorously" protested the incident and called Russia's 10-day delay in announcing what had happened "cynical failure."

President Eisenhower said two days after the Russian announcement that the U.S. is "ready and willing" to have the United Nations Security Council act on Russia's request for an "urgent" meeting to consider what it called the "threat to the peace of the world" posed by renewed Air Force activity against the Soviet.

U-2s Shipped to U.S.

Washington—Three National Aeronautics and Space Administration Lockheed U-2 aircraft operating in Japan since May 1957, have been returned to the U. S. by ship. Three additional NASA U-2s remain in Turkey. All six have been grounded since May 1, when a Turkey-based reconnaissance aircraft was downed inside Russia.

U-2s in Japan were based at U. S. Naval Air Station, Atsugi, 20 mi. from Tokyo. Foreign Minister Aiichiro Fujiyama said Japan did not request withdrawal, but there was considerable uneasiness over the fact that they were located so close to Tokyo. Soviet Premier Nikita Khrushchev threatened destruction of bases from which spy planes are flown.

Snooping Soviet Trawler

Washington—Heavily instrumented Soviet trawler Vega conducted a full-scale electromagnetic snooping expedition along the Atlantic coastline (AW May 16, p. 53), coming to within 12 mi. of the entrance of Chesapeake Bay on Apr. 27, the Navy said last week.

In an announcement obviously aimed at helping to counter Russia's statements on the shooting down of a USAF RB-47, Navy said the trawler had no fishing gear but carried 11 antennas capable of monitoring "every conceivable radio, radar and electronics frequency."

The 200-ton trawler was accused by Navy of interfering with operations of the nuclear submarine George Washington in its launchings of dummy Polaris missiles in international waters off the northeast U.S. coast on Apr. 26.

A day later, Vega passed through a fleet operating area where Air Force and Navy were conducting an air defense exercise. It was shadowed by Lockheed P2V patrol aircraft and destroyers, and many photographs were taken. On one occasion, all of Vega's antennas were removed from their mounts. Navy said Vega is a vessel of the Okean class and carries a large crew, including at least one woman.

In contrast to handling of the U-2 incident by the U. S. government, statements on the RB-47 case have been limited almost entirely to official documents such as the State Department's protest note and statements by President Eisenhower that have been carefully checked with Secretary of State Christian Herter.

Pressure against U. S. allies over base agreements was felt most heavily in Britain, where the Labor Party has been pressing the Conservatives for clarification of what rights the U. S. has there. Prime Minister Harold Macmillan promised to take up with President Eisenhower "the question whether there should be any modification or improvement" in current arrangements.

Several days before the RB-47 announcement, Khrushchev had said that Soviet rockets now can hit unerringly any sector in any part of the globe, and had related his remark to the fact that the U. S. still has a major naval base at Guantanamo Bay, Cuba (AW July 11, p. 33). President Eisenhower had replied that the U. S. will never permit international communism to dominate any government in the Western Hemisphere.

At his press conference on the RB-47 incident, Khrushchev repeated his statement on rocket accuracy, asked what right the U. S. had "to dispose of the destinies of other countries and other peoples," said the U. S.-Cuban treaty concerning the Guantanamo Bay base does not even have a time limit, and said "the Monroe Doctrine has outlived its time, has outlived itself, has died, so to say, a natural death. Now the remains of this doctrine should best be buried as every dead body is so that it should not poison the air by its decay."

Khrushchev called the RB-47 flight "the new gross violation of our country's airspace by an American warplane"—although Russia claims its territorial waters extend to only 12 mi. from land. He said the aircraft was headed toward Archangel.

Russia claimed the RB-47 carried two 20-mm. cannons and ammunition. Asked if these were fired, Khrushchev said this was a question for "the military and the court. In any case guns are installed in a plane not to sign IOUs."

Ceiling of the RB-47 is about 45,000 ft., Khrushchev said. "These planes are within the range of anti-aircraft fire. It goes without saying that they can be easily destroyed by fighters and consequently no rocketry is needed to destroy them.

"However, the whole of American strategy is based on the use of these bombers. So, it has the same lot in store for it as that which befell the plane which made its provocative flight on July 1."

Reds Down 17 U.S. Craft in Decade

Washington—The recent RB-47 incident brings the total number of U. S. aircraft shot down by the Soviet Union over the past 10 years to 17 and the number of crewmen dead or missing from these flights to 91, Sen. Kenneth Keating (R.-N. Y.) said last week.

Keating urged continuation of reconnaissance flights, saying: "We cannot give up defense missions over international waters simply because they're touchy about it." He is sponsoring legislation which would make pilots of aircraft attacked by the Soviets eligible to the same major benefits as the veterans of World War II and the Korean war.

Following are the cases listed:

- **Navy Consolidated Vultee PB4Y-2** shot down in the Baltic Sea, Apr. 8, 1950. Ten crew members are missing.
- **Navy Lockheed P2V** shot down off Vladivostock, Nov. 6, 1951. Ten crew members are missing.
- **USAF Douglas C-47**, driven over Hungary by strong winds unknown to the crew, intercepted by Soviet fighters and forced to land at Papa, Hungary, Nov. 19, 1951. Crew was returned to U. S. custody.
- **USAF Boeing RB-29** shot down by Soviet fighters off northern Japan within Japanese territorial waters in the vicinity of Nemuro, Oct. 7, 1952. Eight crew members are missing.
- **Navy P2V,** conducting routine patrol in the Formosa Strait, damaged by Red Chinese shore battery fire off Swatow and crashed in the ocean, Jan. 18, 1953. Seven crew members rescued; six are missing.
- **Two USAF Republic F-84** jet aircraft attacked over the U. S. zone of Germany near the Czech border while investigating the radar-detected presence of two unidentified aircraft, Mar. 10, 1953. The unidentified aircraft turned out to be two Communist MiG-15s which flew out of Czechoslovakia, shooting down one F-84. The pilot was returned to U. S. custody uninjured.
- **USAF Boeing RB-50** shot down without warning by Soviet MiG-15s over international waters of the Sea of Japan while performing a routine navigation mission, July 29, 1953. One crew member survived, 16 are missing.
- **Navy P2V** shot down without warning over international waters off the Siberian coast by two MiG-type aircraft with Soviet markings while conducting a routine patrol mission, Sept. 4, 1954. Nine were rescued, one is missing.
- **USAF RB-29** shot down by two MiGs while flying a routine mission on the east coast of Hokkaido and crashed in Japanese territory near Nemuro, Nov. 7, 1954. One crew member killed, 10 were injured.
- **Navy P2V** attacked without warning by two Soviet jet fighters while conducting a routine flight over international waters in the Bering Strait, June 22, 1955. The P2V was so damaged that it was forced to crash land on the shore of St. Lawrence Island, U. S. territory. The crew remained in U. S. custody.
- **USAF North American T-6** training aircraft shot down when it inadvertently flew over the de-militarized zone in Korea, Aug. 19, 1955. One crew member killed, one injured was returned to U. S. custody by North Korea.
- **USAF North American F-86** shot down by North Korean anti-aircraft fire when it inadvertently strayed over the de-militarized zone in Korea, Mar. 6, 1958. Injured pilot was returned to U. S. custody.
- **Navy Martin P4M** shot down without warning while on a routine patrol of the Formosa Strait by Red Chinese aircraft 32 mi. each of Wenchow, Aug. 22, 1956. Sixteen are missing.
- **USAF Douglas C-118**, which strayed across the Soviet border of Armenia in bad weather, intercepted by two Soviet MiG fighters and shot afire, causing it to crash land in Soviet territory, June 27, 1958. Nine crew members, including one injured, were returned to U. S.
- **USAF Lockheed C-130** shot down by Soviet fighters when it strayed into Soviet territory near the Turkish border, Sept. 2, 1958. Bodies of 16 crew members returned to U. S. custody, 11 others are missing.
- **Lockheed U-2,** downed over Soviet territory May 1, 1960. Crew member in Soviet custody (AW June 6, p. 26).

B-58 Crash Cause

Los Angeles—Convair B-58 crash during engine-out tests at Mach 2 (AW Nov. 23, p. 23) has now been determined to have been caused by the inadvertent cutting of two engines instead of the intended one on the same side of the aircraft while in the Mach 2 speed range.

Investigation revealed that the B-58 pilot inadvertently retracted the air inlet spike on No. 3 engine instead of No. 4. This is a maneuver preparatory to cutting an engine at supersonic speed.

Retracting the inlet spike allowed the shock wave to choke the air inlet and shut off the air supply for the engine, causing complete loss of power. When the pilot cut No. 4 engine according to the test plan he lost both engines on the same side and the resultant violent yaw maneuvers broke up the aircraft.

Convair has since run tests cutting a single outboard engine at speed regimes from Mach 1 to Mach 2 without any serious effects.

Soviets May Have Lured RB-47 To Bolster Confidence in Defenses

Washington—There is growing speculation here that the Boeing RB-47 downed by the Soviets was intentionally ambushed to bolster home-front confidence in Russian air defenses, shaken by admissions of Soviet leaders that Lockheed U-2s had been safely penetrating Russian airspace for several years.

The RB-47, which the U. S. said was equipped for "electromagnetic research," presumably was probing coverage and characteristics of Russian radar defenses in the Arctic. The airplane carried a crew of six which is believed to include three electronic countermeasures operators, carried in a special pod inside the B-47 bomb bay.

The Soviets may have used powerful jamming equipment to black out the RB-47's navigation radar and radio equipment, confusing the navigator and causing the aircraft to venture too close to Soviet borders where interceptors were waiting. At a news conference, Soviet Premier Khrushchev said that Russia monitored communications between the RB-47 and a base in Norway.

There also is speculation that the Soviets may have lured the RB-47 closer than normal by an intentional blackout of its early warning radars. Both Soviet and U. S. electromagnetic reconnaissance (ferret) aircraft occasionally head for a major target area, turning away only at the last moment, in an effort to bait the nervous opposition into turning on every available radar, including anti-aircraft missile tracking radars which normally are not operated continuously. Such ferret operations are conducted by single aircraft, rather than a group, to prevent their approach from triggering a major alarm. This is based on the assumption that neither country would launch an all-out nuclear war with an initial attack by only one or two aircraft.

Military reconnaissance of electromagnetic radiation dates back to the earliest military use of radio for communications when it amounted to little more than eavesdropping. With the advent of radar in World War II, ferret activities expanded greatly to include techniques for probing the coverage area of enemy radars in an effort to locate possible blind spots due to local topography or equipment design.

First recorded U. S. use of ferret aircraft for such purpose was in 1943 against Japanese-occupied Kiska in the Aleutians, using a specially outfitted Consolidated Vultee B-24. The mission showed a blind spot in radar coverage, resulting from a volcano, which enabled U. S. bombers to come in undetected at comparatively low altitude.

Equally important function of ferret reconnaissance is to determine the characteristics of enemy radar signals for use in developing jamming and electronic countermeasures equipments and techniques.

Because the electromagnetic radiation from one country's radios and radars does not stop at its borders, ferret activities can be carried out by another nation from outside the former's borders. Because radars and most military radio equipments operate at VHF, UHF or microwave frequencies, which are limited to line-of-sight range due to earth curvature, it is desirable to get reasonably close to a country's border in order to probe the characteristics of radars in the interior. Reconnaissance range is increased when the ferret receiver antennas are elevated in height, which is why aircraft are widely used.

For countries bounded by water, or unfriendly countries, whose maximum dimension is no more than 600 to 800 mi. at its widest point, it is possible to reconnoiter all electromagnetic radiation, even in the interior, without physically crossing the country's boundaries. Such is not the case for a large country like the Soviet Union, which explains why the recently downed U-2, according to Soviet reports, carried ferret receivers. But since early warning radar is located primarily around the periphery of a country, the bulk of electromagnetic reconnaissance does not require border penetration.

The extremely sensitive receivers used to intercept electromagnetic radiation from radar and radio transmitters can be installed in submarines and aircraft.

Although Khrushchev, in a recent news conference on the RB-47 downing, did not specifically charge the aircraft with an intentional intrusion of Soviet borders, his heated charges were intended to imply a deliberate violation.

There appears to be no valid reason for a physical penetration of the Soviet border on a ferret mission, unless a very deep physical penetration is intended, in which case the RB-47 is not the logical vehicle for the job. To venture a few miles inside the Soviet borders intentionally, merely in the hope of probing a few miles deeper into radar defenses, would hardly justify the risk.

Furthermore, any Soviet radar so located that it could detect an intruder before or at the time it crossed the Soviet borders could be detected by a ferret aircraft without crossing the border. The sensitive receivers carried by ferret aircraft normally can detect energy from a radar at 50% to 100% greater range than the radar can detect the ferret aircraft. The reason is that the radar operates from the echo which has been reflected off the aircraft and has been greatly weakened (attenuated) by the return to the radar antenna.

Barring failure of the RB-47's ferret receivers, which itself would have caused the crew to abort the mission and return to base, the aircraft countermeasures operators should have known that the airplane was under Soviet radar surveillance long before the Soviets knew the airplane was approaching—unless the Soviet radars were blacked out as a lure, and other detection means—such as infrared which emits no radiation—was being used to track the aircraft. If Soviet radars were operating, the crew would have known the heavy risk of interception if the border was closely approached or penetrated.

For these reasons, the United States' official reply to the Soviet charges on the RB-47 appears to square with the logic of the situation when it says the flight was "entirely different in character" from the U-2 incident in May. The U. S. note says the flight was "one of a continued series of electromagnetic research flights well known to the Soviet government to have taken place over a period of more than 10 years. Instructions to the crews of these airplanes rigidly require that the aircraft remain well outside the airspace of Soviet territory."

The host of similar incidents (see p. 29) of ferret aircraft shot down by the Communists during recent years belies the shocked indignation displayed by Khrushchev over the recent RB-47 incident. As one observer put it: "If ferret flights are news to Mr. Khrushchev, he had better beef up Soviet radar defenses and check up on Russian pilots probing U. S. DEW-Line radar defenses. If they're not engaged in ferret work, they must be planning to make a break for freedom."

U. S. Breaks Off Soviet Bilateral Talks

Washington—United States late last week told Soviet Russia that principles of the Monroe Doctrine "are as valid today as they were . . . when the Doctrine was proclaimed." At the same time the U. S. called off scheduled talks on a bilateral civil air agreement one day before Soviet negotiators were to leave Moscow, citing "recent Soviet actions and utterances" as the reason. In his remarks on Russia's shooting down of a USAF RB-47, Soviet Premier Nikita Khrushchev had rejected President Eisenhower's recent reaffirmation of the Monroe Doctrine and said the Doctrine "has died" and "should best be buried."

Disputes May Delay 10 Atlas Complexes

Washington—Unsolved jurisdictional dispute between missile contractors and building trades may further delay operational readiness of 10 Atlas intercontinental ballistic missile complexes now under construction. Labor Department now is deciding how much of the base activation phase is construction and how much is legitimate extension of development work required to make ready missile support systems. Decision is certain to affect Titan and Minuteman site construction.

Defense Secretary Thomas S. Gates ordered Air Force and Army to tighten management procedures after admitting that the three-site Omaha complex has slipped by as much as five months (AW July 11, p. 25). Major delay so far is in Phase I, which calls for delivery by Army of a site to Air Force Ballistic Missile Division ready for ground support equipment. Phase I is the responsiblity of the Corps of Engineers and Labor Department says there is no question that it is all construction. Unless determination is made on percentages of construction vs. technical areas before Phase II (installation and checkout) goes into high gear, stoppages are likely when Convair brings in employes to install support equipment.

Serious Delay Limited

Serious delay in the Atlas program apparently will be confined to the three sites at Omaha and the complex at Francis E. Warren AFB, Cheyenne, Wyo. Phase I work also is under way at Fairchild AFB, Wash., Forbes and Schilling AFBs, Kan., Lincoln AFB, Neb., Walker AFB, N. M., Dyess AFB, Tex., Altus AFB, Okla., and Plattsburgh AFB, N. Y.

One Defense spokesman attributes Atlas construction difficulties to a series of interlaced labor troubles caused by the attempt to accomplish a task at wartime pace but in a peacetime situation.

Rep. Glenn Cunningham (R-Neb.) places part of the blame on the bid jobber system of contracting and he said he will reintroduce a bill in the next session to require prime contractors to name subcontractors at the time of the bid. Malan-Grove Co. has prime contract for the Omaha complex, but 90% of the work is being done by subcontractors. Major portion of work at other sites is done directly by prime contractors.

The government is required by the Comptroller General to award construction contracts to the lowest responsible bidder, with ability to obtain performance bond the criteria for responsibility. Defense spokesmen concur with Cunningham that the contractor-broker system is not desirable; that brokers generally have little experience in managing large organizations and shop around for subcontractors after they have won awards.

Cunningham's measure would prohibit extensive post-award "shopping" and make it mandatory that all subcontractors be identified within five days of the contract award. When a similar bill was introduced in 1957, it was opposed by Defense Department, Atomic Energy Commission and General Services Administration.

In the Omaha job, Malan-Grove awarded subcontracts to 46 firms. Frequently as many as 30 individual firms worked in small areas, with obvious snarls in scheduling, priorities and control.

Complicating the management problem is lack of a single defense "Project Expediter." Ballistic Missile Division comes closest to being manager, although Army Corps of Engineers awards the construction bid and has sole responsibility for Phase I work.

Air Force commends the Army for dedication and skill in the Atlas job, but at the same time feels it has its own capability to manage the vast project. Because of the percentage of work already completed it is not likely that USAF at this time will revive the sensitive issue of establishing its own supervisory engineer corps. Except for such projects as base housing, USAF must go to Corps of Engineers or Navy Bureau of Yards and Docks for construction work.

In the Atlas program, Ballistic Missile Division draws up the basic design with Convair and principal subcontractors so that changes in the system derived during development and test can be coordinated concurrently with base construction. Design then goes to Corps of Engineers Los Angeles Field Office where both Army and Air Force review plans from the standpoint of construction adequacy. The District Engineer then advertises and awards a bid and Army becomes the responsible department for construction quality and time.

Construction Phase

During the construction phase, USAF architect-engineers assist the Army as technical advisers, particularly in areas where choice of materials might affect operation of delicate systems. Air Force also makes acceptances as jobs are completed. In the Omaha complex, USAF has accepted 70% of Phase I work.

Because of the high priority of Atlas sites, Phase II begins before Phase I is completed. Clear responsibility does not shift from Corps of Engineers to Ballistic Missile Division until Phase I is fully accepted. Ballistic Missile Division then supervises installation and checkout of systems for the weapon.

Defense spokesmen say that the sites do not present tremendously difficult engineering challenges, although tolerances are more exact than industrial requirements. Most complex system in Phase I is propellant loading where plumbing must be kept surgically clean.

Defense Department does not consider quality deficiencies out of line with other construction jobs of the magnitude of the Atlas bases, noting the impossibility of having an inspector for every workman.

Several other reasons for construction slippage have been given, one of which is the unusually severe winter in Omaha where snow covered the ground for two months and temperatures did not rise above freezing for several weeks. Another is jurisdictional disputes which have occurred so far, but union officials say they have been scattered and of short duration. Air Force puts a figure of 11,420 man days lost by jurisdictional disputes caused by alleged misassignment of work.

The June 6-27 Convair strike caused a loss of 86,630 man days, some directly lost in Phase II work at site locations, all affecting the total Atlas program.

Soviets Claim Records

Washington—Soviet Union claims helicopter distance and speed records in two classes with the single-rotor Mi-1, and a world glider speed record for women.

Fedor Belushkin flew a 1,000-km. (620 mi.) closed course in an Mi-1 at an average speed of 141.392 kph. (87.8 mph). Russian pilot Anna Geppener flew an Mi-1 straight-line distance of about 550 km. (342 mi.) for a world helicopter distance record for women, according to Soviet sports officials. The flight required 3 hr. 38 min., at 93.7 mph., breaking a record claimed earlier for Tatiana Russiyan who had flown an Mi-1 over a 500-km. (310 mi.) closed course at an average speed of 142.642 kph. (88.58 mph.).

Soviet sports officials also said pilot Anna Samosadova set a world glider speed record for women by flying a single-place Diamant (diamond) glider over a triangular 100-km. course at an average speed of about 87 kph. (54 mph.). The previous 100-km. world record, set by Polish pilot D. Zakara in July, 1959, was 80.961 kph.

Democrats Pledge Reorganization Of Military and Space Programs

By Ford Eastman

Los Angeles—Democrats, at their national convention here last week, renewed charges that the Republican Administration has allowed the nation's military posture and transportation system to decline and has failed to recognize the importance of space technology.

At the same time, the party pledged to eliminate missile, space and limited war gaps, accelerate propulsion programs for missile and space projects, support basic and applied research and to expand air safety programs to accommodate growing air traffic.

In a strongly worded platform adopted at the convention, Democrats made these charges:

• **"Over the past seven and a half years,** our military power has steadily declined relative to that of the Russians and the Chinese and their satellites.

• **"The Republican Administration** has remained incredibly blind to the prospects of space exploration. They have failed to pursue space programs with a sense of urgency anywhere near the equal to their importance to the future of the world.

• **"The Republican Administration,** despite its glowing promises of 'atoms for peace,' has permitted the gradual deterioration of United States leadership in atomic development both at home and abroad.

• **"Over the past seven years,** we have watched the steady weakening of the nation's transportation system. Railroads are in distress. Highways are congested. Airports and airways lag far behind the needs of the jet age."

The platform committee, headed by Rep. Chester Bowles (D.-Conn.), said the party objective is not the right to co-exist in armed camps on the same planet with totalitarian ideologies; it is the creation of an enduring peace in which the universal values of human dignity, truth, and justice under law are secured for all men.

"If America is to work effectively for such a peace," the committee said, "we must first restore our national strength —military, political, economic, and moral."

The platform calls for a recasting of U.S. military capacity in order to "provide forces and weapons of a diversity, balance, and mobility sufficient in quantity and quality to deter both limited and general aggressions."

This is the military strength that must be "erected," the Democrats said:

• **"Deterrent military power** such that the Soviets and Chinese leaders will have no doubt that an attack on the U.S. would surely be followed by their own destruction.

• **"Balanced conventional military** forces which will permit a response graded to the intensity of any threats of aggressive force.

• **"Continuous modernization** of these forces through intensified research and development, including essential programs now slowed down, terminated, suspended, or neglected for lack of budgetary support."

A first order of business of a Democratic Administration, the platform pledged, would be a re-examination of the organization of the armed forces.

"A military organization structure, conceived before the revolution in weapons technology," it said, "cannot be suitable for the strategic deterrent, continental defense, limited war, and military alliance requirements of the 1960s.

"We believe," the platform read, "that our armed forces should be organized more nearly on the basis of function, not only to produce greater military strength, but also to eliminate duplication and save substantial sums."

To meet the transportation problem, Democrats pledged themselves to the establishment of a national transportation policy, designed to coordinate and modernize facilities for transportation by road, rail, water and air.

"The jet age has made rapid improvement in air safety imperative," the party platform said. "Rather than an orderly withdrawal from the airport grant programs as proposed by the Republican Administration, we pledge to expand the program to accommodate growing air traffic."

The platform also promised to develop inland waterways and harbors, support the principle of federal-state partnership in highway construction, free railroads from "burdensome regulations" and support federal assistance in meeting capital needs for urban mass transportation. The platform said the Republican space program is a "catch-all of assorted projects with no clearly-defined, long-range plan of research." At the same time it promised a Democratic Administration would press forward with a national space program in "full realization of the importance of space accomplishments to our national security and our international prestige."

The platform promised to reorganize the program to achieve both efficiency and speedy execution, bring top scientists in for positions of responsibility and undertake long-term basic research in space science and propulsion. In order to "restore United States leadership" in atomic development, the platform promised a new Democratic Administration would do the following:

• **"Restore truly non-partisan** and vigorous administration of the vital atomic energy program.

• **"Accelerate the Rover nuclear rocket** project and auxiliary power facilities so as to achieve world leadership in peaceful outer space exploration.

• **"Continue the development** of the various promising experimental and prototype atomic power plants which show promise, and provide increasing support for longer range projects at the frontiers of atomic energy application.

• **"Continue to preserve and support** national laboratories and other federal atomic installations as the foundation of technical progress and bulwark of national defense.

• **"Give reality to U.S.** international atoms for peace programs and to continue and expand technological assistance to underdeveloped countries.

• **"Consider measures for improved** organization and procedure for radiation protection and reactor safety, including strengthening the role of the Federal Radiation Council, and the separation of quasi-judicial functions in reactor safety regulations.

• **"Provide a balanced** and flexible nuclear defense capability, including the augmentation of the nuclear submarine fleet."

With respect to the regulatory agencies, the platform said the Democratic Party condemns the "usurpation by the executive of the powers and functions of any of the independent agencies and pledges the restoration of the independence of such agencies and the protection of their integrity of action."

The platform said a Democratic Administration would bring all contacts with commissioners into the open and will protect them from any form of improper pressure. It also promised to appoint men to these agencies of ability and independent judgment who understand that their function is to regulate these industries in the public interest. In addition, the platform promised to review agency practices with an eye toward speedier decisions and a clearer definition of what constitutes the public interest.

In regard to national policy machinery, the platform said that the National Security Council has been used not to focus issues for decision by the responsible leaders of government, but to "paper over problems" of policy with agreed solutions which avoid decision.

The platform said it welcomed the study now being made by the Senate Subcommittee on National Policy Machinery, headed by Sen. Henry Jackson (D.-Wash.).

NASA Cites Data Gained by Pioneer V

Washington—Pioneer V space probe is silent after an unprecedented exploration of interplanetary space that provided 138.9 hr. of scientific data from up to 22.5 million miles from earth.

The 94.8 lb. payload, launched Mar. 11 into a heliocentric orbit that will carry it near the orbit of the planet Venus, made its last transmission at 7:33 a. m. EDT on June 26.

The probe was then 22,462,740 mi. from earth, traveling away from the Jodrell Bank radio telescope near Manchester, England, at a relative velocity of 18,621 mph. It had traversed 60% of the distance from the orbit of earth to the orbit of Venus and was 78.9 million mi. from the center of the sun.

Although Pioneer V did not fulfill original hopes that it would transmit from distances greater than 50,000,000 mi., it has contributed what Dr. A. C. B. Lovell, director the Jodrell Bank Station, called "some of the most remarkable discoveries in science."

Great bulk of the data from Pioneer V has been provided by a 5-watt transmitter and received by the 250-ft. Jodrell Bank antenna. The first attempt to query a 150-watt transmitter last May 8, when the probe was eight million miles from earth, was successful but limited use was made of the stronger transmitter because of apparent deterioration of the probe's 28 batteries (AW May 16, p. 34).

At a press conference called to honor Dr. Lovell for his and the United Kingdom's part in tracking U. S. probes, and to review the results of Pioneer V's flight, National Aeronautics and Space Administration's Director of Space Flight Programs Abe Silverstein credits the probe with these achievements:

- **First quantitative mapping** of the interplanetary magnetic field. Existence of such a field had been indicated by theory and by earlier interplanetary flights, but it was "very, very substantially established during the Pioneer V flight," Silverstein said. The field "fluctuates in intensity in a way connected with the solar flaring activity," he said.
- **First quantitative measurement** of the interaction of the solar wind and the geomagnetic field. This field extends at times out to 65,000 mi. and the outermost part oscillates in intensity as a function of solar activity.
- **First real verification** of the ring current. This annular ring is centered at 40,000 mi. from earth and is some 25,000 mi. in diameter. Current flowing westward in the ring is estimated at 5 million amperes.
- **"Discovery that the Forbush decrease,** which is a measure of the decrease in the cosmic ray intensity at the beginning of a solar flare, is wholly an interplanetary phenomena and not associated with the field around the earth."
- **First measurement** of the influence of the solar wind on the Van Allen belt.
- **First measurement** of the size of the solar system by means of a space probe. Soviet Russia's Lunik I was tracked only to 396,000 mi. and the earlier NASA-Army Pioneer IV only to 407,000 mi.

Details of some of these scientific contributions had been reported earlier by those who developed the measuring instruments (AW May 9, p. 32).

Technologically, the probe established the greatest range over which man has tracked, received telemetry from and maintained control over an instrumented vehicle; achieved the greatest velocity of any man-made vehicle, and marked the first use of an interplanetary guidance system, Silverstein said. Pioneer V carried the elements of a guidance system, Silverstein said, "in that we had doppler capability for measuring position in space, which are parts of advanced guidance systems that are to be used in our future investigations."

Lovell said that, although the batteries were in a weakened condition, some of the most useful telemetry came late in the probe's active life, when "the batteries seemed to recover their energies."

Internal and external temperatures were monitored throughout the flight. Temperature of the four solar cell paddles averaged 23F about 12 hr. after launch. Three months later, with the probe some 18,000,000 mi. from earth, paddle temperatures averaged 51F. Internal temperature on the under side of a shelf forming the waist of the payload rose from 18F early in the flight to 30F as the probe flew closer to the sun.

The payload was developed for NASA by Space Technology Laboratories, Inc., and launched with a Douglas Thor-Able by Air Force's Ballistic Missile Division and STL (AW Mar. 21, p. 28).

Despite plans for more joint U. S.-U. K. space programs, Lovell said that "some of us regard as absolutely necessary" a separate British space program "if we are to go on and survive as a reasonably technological nation."

Further development of the Blue Streak and Black Knight rockets with space payloads for them would place demands on British engineering and industry that "will not be faced if we merely have to instrument American payloads," Lovell said. Dropping rocket development "for the sake of a few million pounds" because a military decision has been made not to use rockets "would be a grievous error . . . because the whole military strategy is clearly in a phase of being transformed. And at the moment no one can see where we should be in the next one or two decades."

Tiros Querying Stops

Washington—Tiros I experimental weather satellite, which transmitted 22,952 photographic frames to earth from its 450-mi. orbit since it was launched last Apr. 1, no longer is being interrogated.

Interrogation was suspended temporarily June 17 after more than 200 hr. of camera operating time. Attempts to resume interrogation on June 28 and 29 "indicated that the satellite's effective operating lifetime was at an end," National Aeronautics and Space Administration said.

NASA speculated that an inoperative relay in the wide-angle camera system prevented turning that camera off. This apparently drained battery power and burned out the camera's transmitter. Although "some limited operational capability" remains in the narrow-angle camera system, Tiros' attitude sensors are not working and without attitude information or wide-angle photos it is almost impossible to identify and orient the narrow-angle photos.

More than 60% of the 5,815 narrow-angle shots and 17,137 wide-angle shots produced good quality cloud cover photos useful to meteorological research, NASA said.

Lunar Vehicle Studies

Four companies have been selected for five-month studies leading to a program for soft landing of an instrumented spacecraft on the moon, in a follow-on to the National Aeronautics and Space Administration's Ranger program. NASA's Jet Propulsion Laboratory awarded the contracts to Hughes Aircraft Co., Culver City, Calif.; North American Aviation's Missile Division, Downey, Calif.; McDonnell Aircraft Corp., St. Louis, and Space Technology Laboratories, El Segundo, Calif.

Each company will work independently on a study, to be submitted to JPL in December, to establish design factors, size, weight and impact velocity of the instrumented lunar package.

The soft landing vehicle is scheduled to be launched by an Atlas Centaur. The earlier Ranger hard landing program is scheduled to land a seismometer on the surface of the moon sometime in late 1962 or early 1963, at an impact velocity of less than 300 mph.

House Unit Urges Establishment Of National Ocean Study Program

Washington—House Science and Astronautics Committee has called for a vastly expanded national effort in oceanography to meet the Soviet submarine threat and to exploit the untapped resources of the sea. The committee opened the door to formation of a new federal agency to plan and coordinate all ocean research beginning next fiscal year.

In a 180-page staff study on "Ocean Sciences and National Security" the House unit concludes that none of the military and scientific agencies currently engaged in oceanography have pushed effective research programs. The study particularly scores Navy's lack of urgency in this science, despite its importance in effective anti-submarine defense, and suggests that an expanded program be concentrated more in civilian agencies.

The study emphasizes the need for an urgent national program in oceanography primarily to better understand the medium in which the large Soviet submarine fleet operates. The ocean also is likened to space as an area with great scientific and propaganda value.

Navy's Interest

Navy's immediate interest in oceanography is concentrated in understanding sea phenomena as they influence acoustics in detecting and localizing underwater targets. Specific areas affecting sonar operation not presently known are ambient noises from winds; scattering, reverberation and noise from swells and waves; temperature gradient, salinity, biological organisms and internal waves; deep velocity profile effects on long range beams; slope, roughness and bottom composition, and ice thickness and roughness.

Program Costs

In the past three years, studies on long-range national programs have been conducted by the National Academy of Sciences Committee on Oceanography (NASCO), Interagency Committee on Oceanography (ICO) and the Navy, which calls its program TENOC, for 10-year program on oceanography.

NASCO recommended a 10-year expenditure of $867 million, with an annual cost of $68 million after 1969. This program would involve construction of 70 new ships and provide $15 million to educate oceanographers.

The ICO 10-year program would cost $1 billion, with annual cost leveling off at $85 million after 1969. The ICO proposal includes 78 new ships.

For the current fiscal year, NASCO recommended a budget of $86 million and ICO $120 million to support oceanography. Requests by government agencies (Navy, Department of Commerce, Department of the Interior, National Science Foundation and Atomic Energy Commission) totaled $55 million. Congress appropriated the full amount requested.

The U. S. research fleet consists of 50 vessels, 32 classed oceanographic and 18 hydrographic. Average age of these vessels is 18 years, and all but 15 are scheduled to be replaced by 1970.

Navy's TENOC program deals mainly with basic and applied research in contracts to universities and institutions. It is a $75-million project for 18 research ships and new laboratories. In-house operating budget under this project would total $183 million over the next 10 years.

The House report urges the Navy to increase its emphasis in deep-diving submarines and bathyscape research, since the current depth limit of submarines is 700 ft. Because of the urgency Russia is placing in oceanography, a deep-diving vehicle is considered a potential USSR development.

The report notes that 65% of the ocean is more than 12,000 ft. in depth and 40% is more than 15,000 ft. deep.

Reynolds Metals Co. is constructing a three-man, 33-ft. submersible capable of operating at 15,000 ft. depth and will make the craft available to the Navy. The "Aluminaut" was designed at Southwest Research Institute under a proprietary Reynolds program.

Navy would use the craft both for oceanography as well as for research in structures, hull design, propulsion and controls.

Aerojet, Grand Central Win Rocket Awards

Aerojet-General Corp., Azusa, Calif., and Grand Central Rocket Co., Redlands, Calif., have been awarded Air Force contracts for applied research leading to development of large segmented solid propellant rocket motors. Development will involve scale model hardware aimed at establishing the feasibility of a 1 million-lb. thrust solid propellant booster, and is the result of a re-evaluation of industry proposals by Wright Air Development Division (AW May 30, p. 93). Aerojet's contract amounts to approximately $4 million, Grand Central's contract value probably will run half that amount. Contracts will run for approximately one year. Under the contracts, Aerojet probably will proceed with the segmentation feasibility, while Grand Central will explore improved methods for achieving this approach. Aerojet already has fired a small-scale segmented rocket-section.

Sen. Douglas Scores Defense for 'Waste'

Washington—Sen. Paul Douglas (D.-Ill.) last week launched a major campaign to stress what he charged were wasteful practices in Defense Department procurement by focusing on the extreme prices paid for commonplace items.

He has referred approximately 1,000 small procurements for which Defense allegedly paid extravagant prices to the General Accounting Office for thorough investigation.

Douglas' move was touched off by a 30-page Defense Department document, refuting claims he made in a Senate speech June 13 charging excessive pricing of 10 items. These included:

- **Cable headset** which Air Force purchased for $10.67, and which is now being sold commercially for $5.33. Defense explained the equipment was specifically designed for USAF requirements.
- **Wrench set** for which Douglas said Army paid $29 and which General Services Administration sells for $4.50. Defense said Army has purchased none of the sets since World War II. "The item displayed by Sen. Douglas was declared surplus by National Security Agency in 1958, and a price for record purposes was then established at $29," Defense stated. "As no Army purchase action has been taken on this item since World War II, the actual purchase price is not available as all applicable records have been destroyed."
- **Lamp socket** for which Navy paid $21.10, and which Douglas had appraised at 25 cents. Defense said that Douglas' information was "erroneous" because "a clerical error was made in applying the price and stock number of a complete lamp holder assembly, including the socket, to the socket itself. This price of $21.10 was never paid for the socket alone."

Defense concluded that "there is no evidence of its having paid excessive prices" for any of the 10 items named by Douglas. Douglas responded that the statement illustrated that "Defense will not admit making a single mistake with respect to their procurement and supply practices but stubbornly defend their position." He referred the 10 cases, along with the 1,000 additional items, to General Accounting for investigation.

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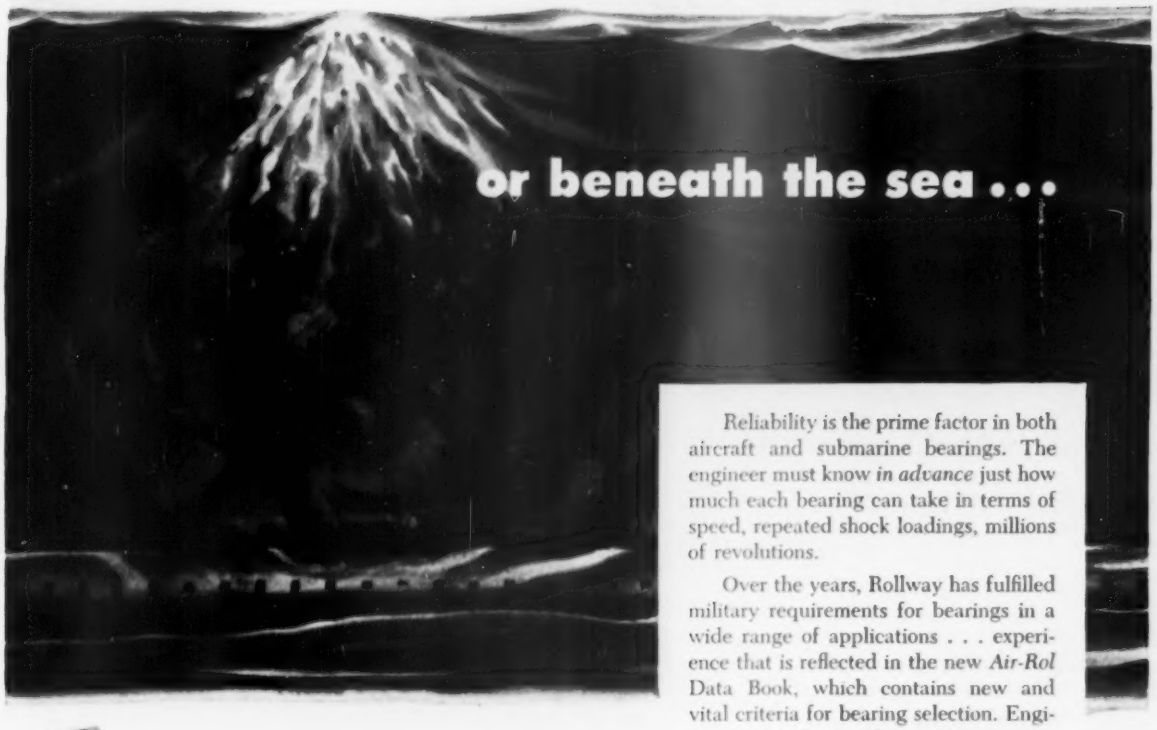

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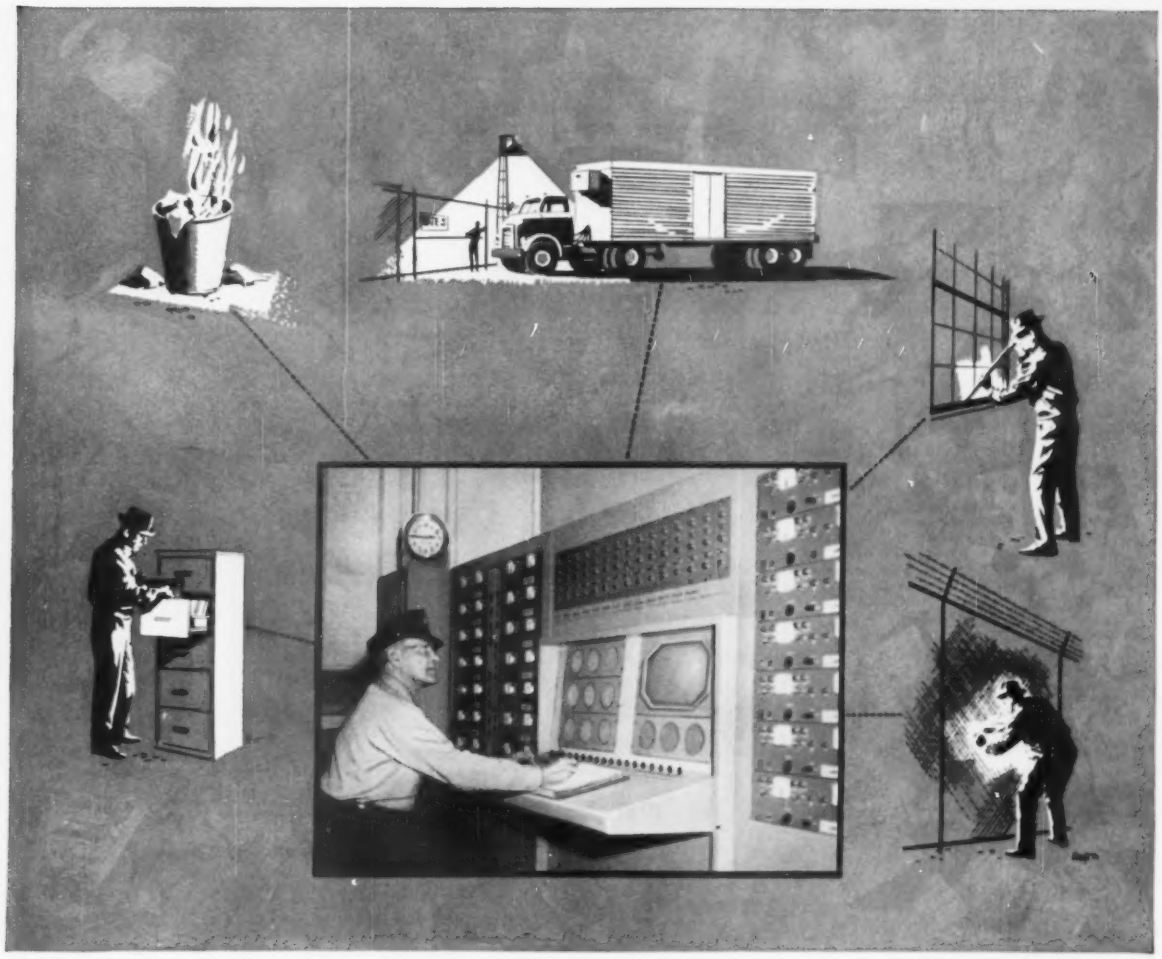

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75 YEARS PIONEERING THE FUTURE

Satellite to Test Orbital Network Plan

By Philip J. Klass

Washington—Within several years, Bell Telephone System plans to place an experimental active communications satellite in orbit, the forerunner of a commercial space communications network which may ultimately span the globe and provide 600 two-way voice channels and one television circuit. Cost of the global system is estimated at around $165 million.

Global coverage is based on placing about 50 repeater satellites in random orbit at an altitude of 3,000 mi. American Telephone & Telegraph Co. already has had preliminary discussions with several organizations, including rocket booster manufacturers, which have proposed to handle the satellite launch.

The company's current plans and thinking on commercial communications satellite systems—without a firm timetable—were disclosed in recent written testimony filed with the Federal Communications Commission. The Bell System statement, and the views of 17 other companies, organizations and government agencies, were in response to the FCC's request for views on allocation of frequencies for space communications in connection with its Docket 11866, dealing with spectrum allocation above 890 megacycles.

Lockheed Aircraft Corp., another respondent, said that technology has now advanced to the point where it is possible to provide an operational space communications (satellite) system for voice communication between Western Europe and the Western Hemisphere within three years from decision to proceed.

Radio Corporation of America reported it believes that a commercial satellite communication system capable of transmitting television pictures between U. S. and Great Britain could be ready for trial commercial usage by 1965, with extensive international systems operational by 1970.

Organizations that commented to FCC were in general agreement that space communications systems appear to offer many attractive operational and economic advantages, compared with existing submarine cables and radio communications, but differed sharply over frequency allocations.

American Telephone & Telegraph Co. (Bell Telephone System) recommends that FCC reconsider last year's decision to allocate frequencies above 890 mc. for private microwave communication systems in view of the recently developed needs of space communication systems. This position was supported also by General Telephone & Electronics Corp. The AT&T position is that unless this is done, the frequencies required for a communications satellite system will be taken by other services, including private microwave systems. This will either seriously restrict usefulness of space communications system or force it to share bands with the other services and result in mutual interference between services.

The Electronic Industries Assn., and a number of electronic manufacturers, take sharp issue with AT&T. Their view is that the two types of services can share common portions of the spectrum without objectionable interference. FCC is scheduled to hear oral arguments by representatives of opposing points of view this week.

Bell Telephone System studies indicate that a space communications system consisting of about 50 active repeater-type satellites, placed in random polar orbits at an altitude of 3,000 mi., could provide direct communications between the U. S. and all areas of the world, without using intermediate facilities of other countries. System would require 26 transmitter-receiver installations situated in the U. S. and in key spots around the earth.

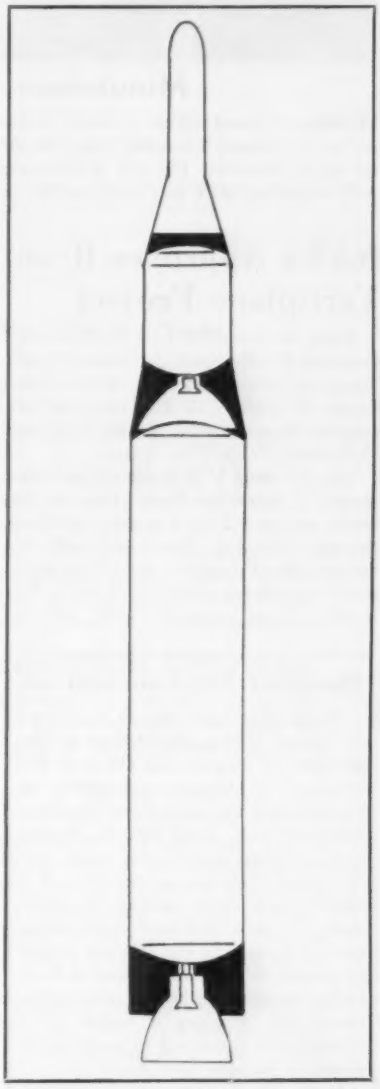
Based on the use of a launching vehicle such as the Atlas-Agena, with payload capacity sufficient to handle several satellites in a single launch, AT&T studies indicate it will cost between $500,000 and $4 million for each satellite placed in orbit. Figure includes cost of building satellite, launching vehicle and launch facilities rental. In estimating over-all system costs, the company used a figure of $1 million per satellite in orbit. If the satellite is to provide one television channel in addition to 600 two-way voice circuits, the cost would be roughly double. Estimate for the 26 ground installations is about $2.5 million each. This brings total global system cost for 26 ground stations and 50 satellites, with telephone circuit capability only, to around $115 million, or about $165 million if television circuit also is included.

A starter system, providing 600 voice circuits between Honolulu, the U. S., and Western Europe, would require only 30 satellites and eight ground stations, for a total cost of $50 million, AT&T estimates. On a per-circuit basis, the company says the space communications system would be "substantially" lower than cost of the latest, most efficient submarine cable now under design, which itself is less expensive than cables now in use.

This cost comparison is based on an average service life of 10 years for the satellite payload; at a 3,000-mi. orbit the satellite itself would have a far longer life.

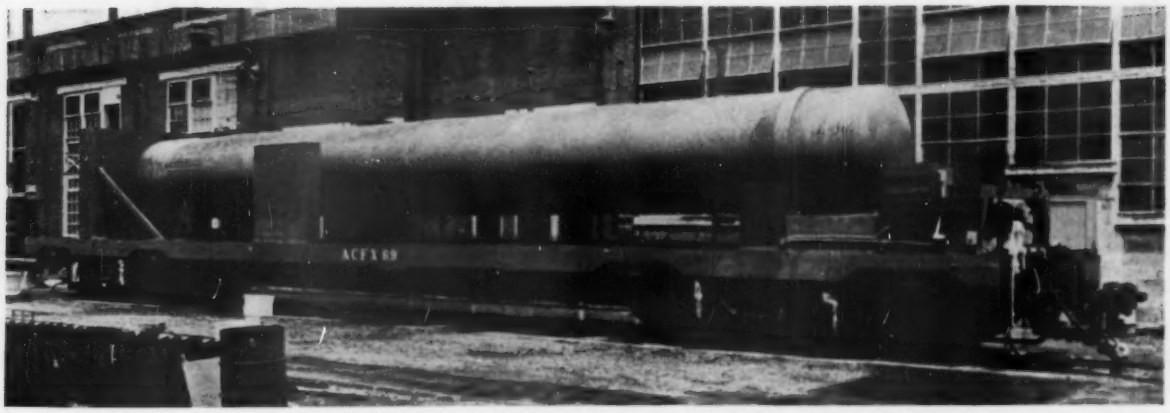
Experimental communications satellite now under design by Bell Telephone Laboratories is expected to weigh about 150 lb. and measure about four feet in diameter. It will be powered by solar cells and chemical batteries.

The planned space communications system is expected to be a joint international venture.



New Rocketdyne Nozzle

Shortness of the "expansion-deflection" (E-D) nozzle, developed by Rocketdyne, allows reduced interstage structure and significant weight savings when used on upper stages of multi-staged vehicles (AW June 6, p. 113). Nozzle was not developed for a particular engine, but will be applied to new engine concepts.



Minuteman Railroad Car Suspension System Tested

Minuteman railroad test car is used to evaluate the protection afforded the missile by the air-coil spring suspension system. Instrumented car carries a dummy simulating actual Minuteman load characteristics and is subjected to a variety of impacts exceeding those a missile train car might encounter. Car will be road-tested following evaluation at the Berwick, Pa., plant of American Car and Foundry Division of ACF Industries. ACF and American Machine and Foundry Co. are developing missile car and command car for Minuteman train.

NASA Approves Ryan Vertiplane Project

Ryan Aeronautical Co. has been authorized by National Aeronautics and Space Administration to rebuild the Ryan VZ-3RY Vertiplane, which crashed on a test flight earlier this year (AW Feb. 29, p. 93).

The tilt wing VTOL plane had completed 21 successful flights prior to the crash, which followed a sharp pitchup through 180 deg. Ryan originally developed the Vertiplane for U. S. Army under cognizance of Office of Naval Research. Final assembly work will be done by NASA personnel at Ames Laboratory, Moffett Field, Calif., where flight testing will be resumed.

In another VTOL development, Vanguard Air and Marine Corp., builders of the Vanguard 2C fan wing now completing tunnel tests at Ames (AW Oct. 19, 1959, p. 128), said it will install a Lycoming T53 turbine in the plane, under a cost reimbursement contract from Wright Air Development Division.

Edward G. Vanderlip, Vanguard president, said the turbine-powered Vanguard will undergo tethered tests next October and then be returned to Ames for further tunnel testing. Vanguard shareholders have approved a merger with Northeast Metals Industries, Inc., Philadelphia, Pa., following director approval (AW July 11, p. 145).

Missileer Implementation

Washington—Navy Bureau of Weapons still is making presentations to Department of Defense and Office of the Secretary of Defense on feasibility of implementing the carrier-based Missileer, scheduled to be fitted with the Bendix Eagle air-to-air missile now under development. Decision on selection of a Missileer contractor already has been made but new high-level deliberations now are considering the Missileer project in relation to Navy and general defense budget requirements several years in the future, also weighing it against other projects now envisioned to come in existence in the same time period.

If the Missileer program is not implemented, it is likely that Eagle missile development also will be killed, unless another vehicle is selected to be armed with it. Major modification program would be required for any existing aircraft to carry the missile. Another hurdle is that existing planes would not have enough time on station to meet present-day operational techniques.

News Digest

Richard E. Horner resigned as associate administrator of National Aeronautics and Space Administration to become senior vice president for technological matters at Northrop Corp. effective July 15. USAF Col. Bentley H. Harris, Horner's special assistant at NASA, is leaving the space agency to attend the National War College.

Army-Strongarm project continued last week with three five-stage rockets launched from Wallops Island, Va., to measure electron densities up to 1,000 mi.—altitudes where Nike Zeus will intercept ICBMs.

Ditching of a Northwest Orient Airlines Douglas DC-7C last week near the Philippines followed the reported loss of a propeller and wing fire. One of the 58 persons aboard the Manila-bound flight was killed and all others rescued.

Stockholders of Ling-Altec Electronics, Inc., and Temco Aircraft Corp. voted in favor of merger.

Massachusetts Institute of Technology will construct world's most powerful magnet, part of new Magnet Laboratory to be built under a $9.5 million contract from Air Research and Development Command, for basic research in magnetic fields and their effects. Magnet will produce continuous magnetic field with strength of 250,000 gauss, 500,000 times the strength of the earth's magnetic field.

Boeing Airplane Co. received formal $247 million USAF-Minuteman contract to cover research and development through 1961.

Westland Westminster prototype helicopter made its first flight last week with a six-bladed rotor head.

Terne Missile Contract

Washington—Navy has signed $1.5 million research and development contract with Arma Division, American Bosh Arma Corp., for Norwegian-developed Terne missile system.

Terne is similar to Avco Weapon Alpha but is lighter and more compact. Alpha weighs 500 lb. and has range of 900 yd. It has been in fleet use since 1951.

Contract calls for modification of existing fire control equipment and systems integration for fleet test of the Terne. New launchers are required for the missile, which was developed by Norwegian Defense Research Establishment and is manufactured by Kongsberg Vapenfabrikk.

Trunkline Traffic Falls Below Predictions

Prospect of reaching 14% gain originally forecast for 1960 seems slight in view of slack first half.

By L. L. Doty

Washington—A sharp dip in trunkline business during the first half of 1960 from last year's traffic growth trend has created an atmosphere of pessimism over any prospects of reaching the 14% traffic increase originally forecast for the year.

Although the 12 domestic trunkline carriers registered a 7.6% gain in passenger revenue miles during the first six months, the increase was disappointing in view of the healthy business conditions prevalent during the period. In addition, growing concern among business analysts that the pace of the economy may be slackening is casting some question over the airline industry's chances of recovering sufficiently during the balance of the year to come even close to 1959's impressive 15% gain in revenue passenger miles.

Earlier Commerce Department forecasts of an annual $510 billion gross national product—output of all goods and services—by the end of the year will probably be revised shortly to $506 billion. As originally pointed out by AVIATION WEEK (AW Feb. 29, p. 38), airline traffic activity closely parallels the peaks and valleys of the gross national product after seasonal adjustments have been made.

Thus the gross national product serves as an indicator in projecting annual growth trends of trunkline business. The 14% gain forecast for the year 1960, suggesting that some 15.5 billion revenue passenger miles should have been accumulated by June 30, was based on the predicted $510 billion annual gross national product.

First Half Traffic

Actual revenue passenger miles flown during the first six months of the year by the trunklines reached an accumulated 14.44 billion by June 30. Annual gross national product at the end of the second quarter was $503 billion, according to President Eisenhower. Although this was a $3 billion rise over the first quarter of 1960, the increase fell far short of the $16.7 billion jump in the annual gross national product at the end of the first quarter over the previous three-month period.

Consequently, the dip in the economy is reflected in a weakening of airline traffic activity. On the basis of this change in the economic picture, it is now forecast that revenue passenger miles will reach 30.3 billion by the end of the year compared with the 28.1 billion flown in 1959.

A further indication of traffic trends thus far this year is shown by the quarterly increases in revenue passenger miles. In the first quarter of the year, the airlines experienced an 8.9% increase in revenue passenger miles. In the second quarter, the gain was only 6.7%.

First quarter gains were registered in the face of a traffic depression during March when total revenue passenger miles fell 1% under the total flown in the previous month and the load factor plummeted to 55.7%, lowest reached in several years.

In addition, the month of June, historically the first of the summer's peak months, showed a revenue passenger mile gain of only 3.4%. Load factor for the month was 66.8%, a seven-point climb over the May load factor, but a two-point decline from last June's level.

Another significant pattern which emerged during the first six months of 1960 and which threatens to change the entire complexion of the domestic trunkline industry is the narrowing gap between coach and first-class traffic.

During the month of June, coach revenue passenger miles climbed to 1.35 billion to equal the 1.35 billion first-class revenue passenger miles generated in the same period. It is the first time in airline history that coach traffic has equaled first-class traffic in volume.

Coach Traffic Trend

Furthermore, during the first six months, first-class revenue passenger miles totaled 7.74 billion—no change from the 7.74 billion generated in the first six months of 1959. However, coach traffic climbed 18.6% in the same period to reach 6.70 billion revenue passenger miles. It is strongly evident that, if the trend continues—as it is expected to do, coach traffic will soon outstrip first-class traffic to be-

American Electra Modification Program

New York-American Airlines and Lockheed Aircraft Corp. signed a contract last week covering modifications of the carrier's 34 Electra turboprop transports, with work to begin in November and Lockheed paying all but a nominal share of the cost.

The modification program, which is expected to cost the manufacturer about $25 million for all Electras in airline service, will involve a production line with about 20 positions. Lockheed expects to have reached firm agreements with all domestic customers in about two weeks, then to sign contracts with foreign operators over a period of about another month. Modifications are designed to correct wing conditions which apparently led to two Electra accidents (AW May 16, p. 40).

American's costs in the program will be confined to the expense of ferrying the aircraft to Burbank and back and test flying them. This is the pattern all the contracts are expected to follow.

Scheduling of American's Electras calls for delivery of five at a time to Burbank, with work on the entire fleet to be completed by July, 1961. It is understood that Lockheed hopes to receive Federal Aviation Agency certification of the modified aircraft around Dec. 16.

American has not decided whether speed restrictions will be removed from each modified airplane as it is returned to service, or whether the restriction will continue until the whole fleet is modified.

The modifications consist of the addition of attachments between the engine and its mount; additional attachments between the mount and the aircraft structure; beefing of the wing planks which run out from fuselage toward wing tip, and stiffening of some intermediate ribs by the addition of new bracing. The additions are designed to eliminate the coupling of forces considered responsible for the wing failure believed to have caused two fatal Electra accidents.

Aft-Fan Type Turbojets Power Soviet Tu-124

Aft-fan type turbojet engines designed by Soloviev are being used by the Soviets to power the new Tupolev Tu-124 medium-range, 44-seat transport (AW July 4, p. 41). A. A. Arkhangelsky, top assistant to A. N. Tupolev on the Tu-124 project, said the aircraft was powered by two turbofan engines on which "the front part . . . does not differ at all from a conventional turbojet. It has the same compressor, combustion chamber and gas turbine. However, with the turbofan engine, the gases, in passing through the main turbine, encounter yet another one—the so-called fan turbine which is not connected mechanically with the main turbine." Arkhangelsky is the first Russian designer to use the term turbofan to describe the new engines. Previously they have been identified as "double contour" engines by Soviet engineers in public discussion. General appearance of the Tu-124 is similar to the other transports in the Tu-104 family but its landing gear is about one foot shorter than that on the Tu-104, its fuselage is shorter, and its wing leading edges and engine air duct lips are sharper. These wing and duct changes were necessary because the Tu-124 cruises closer to Mach 1.0 than the earlier Tu-104 and Tu-104A which are powered by pure turbojet engines. Only other apparent change on the new smaller transport is an increase in engine air duct inlet area for the fan engines. Arkhangelsky was recently promoted to the status of general designer and has entered the circle of top Soviet aircraft engineers with Tupolev, Mikoyan and the other designers whose names are used to identify the aircraft they produce. Arkhangelsky has been deputy general designer in Tupolev's organization for many years and played a major role in the design of the Tu-104 and Tu-114 aircraft.

come the leading service offered passengers. First domestic scheduled coach service was introduced in the fall of 1948.

In June, only five of the 12 trunklines reported an increase in first-class revenue passenger miles and such gains were relatively small. No carrier failed to report an increase in coach traffic and the gains in most instances were substantial.

The industry, during the first six months, produced a total load factor of 57.33% in first-class traffic on 13.50 billion available seat miles. Coach load factor for the entire industry during the same period was 62.85% on 10.66 billion available seat miles. The success that was achieved in first-class business is attributed to increased seat capacity produced by the turbojet aircraft fleets.

Only four carriers reported a load factor improvement during the month of June. The increase of three of the four carriers' load factor performance—Delta, National and Northeast—is attributed to the reduction of schedules by Eastern Air Lines because of labor problems (AW June 20, p. 87).

Braniff Airways showed a load factor increase but Northwest's load factor remained virtually the same during the month. Continental's load factor dropped approximately 10 points.

The trend during the first six months of the year is an enigmatic departure from traditional growth patterns set by the airline industry in the past. Normally, trunkline traffic tends to remain fairly stable in times of general business recession. During the 1954 business decline, when the annual gross national product dipped below levels reached the previous year, airline traffic continued to expand although the rate of expansion was slower than it had been in previous years.

In 1958, when the annual gross national product receded sharply, airline business remained firm, ending the year with an insignificant 0.3% drop from 1957's level. Rail traffic declined substantially that year.

It is the general feeling among a large number of airline economists that airline business should follow a growth pattern even in periods when the general economy settles on temporary plateaus. As a result, with business activity currently at a high level, industry executives are finding it difficult to pin down some reason for the disappointing showing during the first half of 1960.

Turbojet-powered transports are becoming increasingly popular, the accident rate has been cut since the opening months of the year and air travel has been backed this year by the most intensive promotional program ever conducted by the industry. On the economy scene, employment set a new record in May, consumer income has risen steadily for the past six months and consumer retail buying is 3% above the same period last year.

On the dark side, transportation costs in the nation have dropped for the sixth consecutive month as prices on new and used automobiles, tires and gasoline slide downward. At the same time, the airline industry has moved to take advantage of the approximately 4% fare increase granted by the Civil Aeronautics Board. The excise tax remains in effect to further inflate air travel costs.

Competition is becoming keener as more carriers introduce more turbojet and turboprop transports in major travel markets which increases available seat miles but reduces load factors.

The industry produced 24 billion available seat miles during the first six months of 1960 compared with 21.8 billion in the same period last year. Complaints of the quality of service in some areas appear to be growing.

There is serious concern among economists that the business boom which marked the opening of 1960 has already lost most of its strength. Steel production has fallen from 93% in the first week of March to 42% in the second week in July. Talk about a summer rally in the stock market has all but subsided.

Capital Electras

Los Angeles—Lockheed Aircraft Corp. apparently is looking for customers for five Electras now sitting on its line at Burbank, painted with Capital Airlines markings. Capital had a tentative commitment for the aircraft, but Lockheed now says that if the airline is unable to take delivery because of its financial condition, "alternative customers are in the picture."

British Government Will Support VC.10, DH-121, Argosy Programs

By John Tunstall

London—British government will support the Vickers VC.10 and Super VC.10, the Armstrong Whitworth Argosy and the de Havilland DH-121 transports under a new aid program for the aircraft industry, but the extent of support was not disclosed.

The announcement, which took airframe and engine manufacturers by surprise, was made by Aviation Minister Duncan Sandys in the House of Commons.

The full extent of the government financial contribution and contractual arrangements may never be revealed officially, Sandys said.

In a roundup of industry reaction to the new aid proposals, AVIATION WEEK gathered that government support for these four aircraft will be most substantial, and will be in addition to all previous government contributions by way of orders.

General opinion suggests that main objective of the government intervention is to underwrite the production of all four aircraft above current orders up to the breakeven number. The figure in the case of the DH-121 is believed to be 100 aircraft, and the total capital contribution by the government spread over the four aircraft no less than $150 million.

Fund Allocations

This figure would be allocated to the two manufacturing groups in accordance with the number of aircraft already ordered, and the basic cost price of each aircraft.

Armstrong Whitworth, which has sunk $36 million in the Argosy program, expects about $15 million, notwithstanding the 40 military versions on order.

To de Havilland it could mean another $60 million, with the rest going to Vickers.

Both the Hawker Siddeley Group and British Aircraft Corp. emphasize that the treasury contribution is much nearer a loan than a grant and will be subject to a fairly rapid recovery. The government—as commercial partner in the deal—will share the losses and profits throughout the life of each type.

In the announcement, the minister also said that other projects were still under discussion, including the space and the supersonic jet transport programs.

All four sponsored aircraft have three things in common—a well developed production program, modest orders, and roles in clearly distinct, major transport categories. It appears reasonably apparent that no aircraft which does not satisfy these requirements will be eligible for government aid.

In this context, it is thought significant that neither the Avro 748 nor the Handley Page Herald were named as beneficiaries. Yet both are flying, both fill an important transport category and both need more orders.

Similar Problem

On the threshold of a similar problem stand BAC's aspirations to build a scaled-down version of the VC.10 designated VC.11, and cash in on Vickers goodwill with Viscount and Vanguard operators. Although the size and range details of the rear-engine VC.11 have not been disclosed by BAC, it is generally believed—particularly at Hatfield—to overlap considerably the stretch area of the DH-121. Swept-wing VC.11 would be powered by four Rolls-Royce RB-16Cs.

Vickers rejects this situation and maintains there is a distinct range gap for the VC.11 (AW Sept. 28, 1959, p. 52).

The company believes that on the basis of the current market survey with the aircraft, it will win enough takers by autumn this year to approach the government for aid.

Vickers also believes it will obtain government backing for the ex-Hunting P.107 twin jet as an RAF replacement for the Vickers Varsity piston-engined crew trainer and communications aircraft.

"The more we study the P.107, the more we like it" a leading BAC spokesman told AVIATION WEEK. But although the government appears to have indicated its willingness to adopt the basic aircraft, it does not intend to acquire a special aircraft for this role which does not also have a commercial airline potential.

Market Survey

On this point, BAC has still to decide, on the basis of a market survey now proceeding, whether to go ahead with the P.107 as a Viscount replacement. Decisions on both the VC.11 and the P.107 are expected within a couple of months, AVIATION WEEK learned.

BAC has named the Bristol Siddeley BS-75 fan engine as the powerplant for the P.107. The engines are rear mounted.

Only detail changes in the aircraft's systems will be needed to tailor the original Hunting design for airline service.

Sandys also may be considering an Avro fan-engined short haul transport (AW Mar. 14, p. 47) for the dual role.

Officials at de Havilland were elated by Sandy's statement. "It will make a mighty difference to the foreign sales potential of the DH-121," a spokesman told AVIATION WEEK. Besides underwriting the production of aircraft well beyond the order book, it provides assistance for research, development, tooling and proving costs.

Total Aircraft Sales

De Havilland expects to sell another 50 aircraft to British European Airways and 25 to the independents, bringing the total DH-121 aircraft sold to British operators alone to 100 aircraft by 1965.

The company expects to sell more Comets, too, in the next 3-4 years. "Although we no longer expect a large military order for the Comet," one spokesman said, "we expect to sell about 60 Comets to Middle East and South American airlines before the DH-121 enters service."

Allegheny Estimates Convair 540 Costs

Washington—Allegheny Airlines has established 27% as the break-even load factor necessary to meet direct operating costs of its fleet of Convair 540 turboprop transports.

In an exhibit filed with the Civil Aeronautics Board in the Buffalo-Toronto Service Case, Allegheny said that direct operating costs for the Convair 540, which is powered by Napier Eland turboprop engines, were set at 95.36 cents per revenue plane mile. The report covered the first nine months of actual operating experience with the airplane.

Cost per available seat mile was reported at 1.8 cents. Allegheny is operating the airplane with a 52-seat configuration. Breakeven load necessary to meet direct operating costs was computed by the airline at 14 passengers.

Allegheny used a straight-line depreciation policy computed at 6½ hr. utilization at 240 mph. Airframe has been evaluated at $612,500, with a 15% residual value and 120 month life. Total depreciation costs amounted to 20.64 cents per revenue mile.

Total flying operation costs for the nine month period totaled 45.15 cents per revenue mile. Included in these costs were pilots' salaries at 17.58 cents, fuel at 16.61 cents and insurance at 6.59 cents. Total direct maintenance costs were 29.57 cents per aircraft revenue mile.

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CAB Inadequacy-of-Service Ruling Upheld

Washington—In a decision that may have far-reaching effects on airline flight scheduling policy, a U. S. Court of Appeals last week upheld the Civil Aeronautics Board's authority to order a carrier to increase flight service when such service is found to be inadequate.

The decision affirmed a CAB order issued in November calling for the addition of two round-trip coach flights daily by Capital Airlines between Toledo and Chicago, Philadelphia and New York. The case arose from a complaint filed with the Board against the Capital service by the city government and the Chamber of Commerce of Toledo.

As of late last week it was too early to determine industry reaction to the decision. Generally, however, the airline industry has held that the function of scheduling flights is a management prerogative because of operating efficiencies and economic factors involved in a systemwide scheduling program. Capital protested the Board order on grounds that such services were not required and could only be operated at substantial losses to the carrier.

Last month American Airlines filed objections to a Board order calling for the addition of at least one daily flight in the Baltimore-Dallas market (AW June 20, p. 91). In its petition to the Board for reconsideration, American questioned the Board's authority to supervise schedules and said the order carried "broader, long-range implications which threaten literally to wreck the domestic airline system."

In its appeal against the Board order calling for additional service to and from Toledo, Capital also contended the Board lacked the power to direct a carrier to increase service and emphasized that service to Toledo was already adequate. In response to the airline's protests that the service would be uneconomic, the Board had this to say:

". . . even if the proposed service should fail to prove economical during this trial period, the rendition by Capital of this minimum service pattern is required under its certificate and section 404(a) of the Act."

In response to this statement, Capital echoed the views of American when it noted that if this represents a Board view "that carriers will be required to provide uneconomic services even though the systems of these carriers are operating at losses, it is obvious that subsidy will be required to support these required operations." Capital made the statement in a petition for subsidy which has since been withdrawn (AW Apr. 4, p. 47).

The court, in its decision on the Toledo service, seemed to think that inadequacy of service cases would increase in the future and noted that "with major trunkline air services now being established, the Board will be increasingly concerned with securing adequate service for smaller, intermediate cities."

The court decision also asserted that maintenance of competition was essential and that evidence indicated Capital could provide the additional service without economic loss.

Adequate Service

Earlier the Board, in its decision, admitted that United Air Lines, which also serves the four cities involved in the case, was offering adequate service but added that the potential demand between the four cities involved was not being fulfilled. It reasoned that an increase of Capital's service would create competition that would improve United's service and thus "generate the demand necessary to sustain Capital's new flights."

The court agreed with this finding as "justified" but made no decision as to whether the Board could order the addition of competitive service in any market where service was already deemed adequate. According to the court, this is the first case in which the Board has found inadequacy of service and then ordered the authorized carrier to add flights to correct the inadequacies.

Chances are strong that Capital will not appeal the decision to higher courts on grounds that the case, by itself, is not significantly strong enough to risk establishing a legal precedent which could affect future cases of greater importance to the industry. For example, a Board decision in the current CAB New York Coach Investigation could bring about an order directing the implementation of a substantial increase in coach services in short and medium haul markets (AW Mar. 14, p. 38).

In this case, there has been strong evidence that the Board is prepared to establish standards which set the amount of coach service which should be offered in certain markets. The airlines maintain there is no feasible measuring-rod which can be applied to the scheduling of coach service in all markets under all operating conditions.

It is because of these two widely divergent views that a Board decision backing its position could result in a test case that some carriers might be inclined to move into higher courts for appeal. During the hearings in this case, there were strong indications that Hearing Examiner Paul N. Pfeiffer was determined to bring about a decision that would call for the introduction of commuter-type services in high-density short-haul markets at sharply reduced fares. Most trunklines hold that such services are not economically practicable at the present time.

Airline observers here were not necessarily surprised that the Court of Appeals upheld the Board in its decision to charge Capital Airlines with inadequacy of service in the Toledo market or to order the addition of new service. However, they generally had not expected that the court would actually support the Board's decision to order the exact type of service which should be introduced—in this case, coach service.

One solution to the over-all problem of inadequacy of service in markets of moderate traffic density lies in the transfer of a number of trunkline points to local service carriers. Allegheny has already proposed the introduction of no-reservation, low-cost, commuter service in the New York-Washington market (AW July 11, p. 43).

Furthermore, the airline has told the Board that it is ready to replace Capital Airlines' services at many points at which Capital is seeking suspension. Earlier this month (AW July 4, p. 44), Capital asked the Board for permission to drop points on its system which "possess local service and low traffic density characteristics" as a means of strengthening its route structure. Toledo was one of the cities Capital wished to eliminate and one of those which Allegheny wished to acquire.

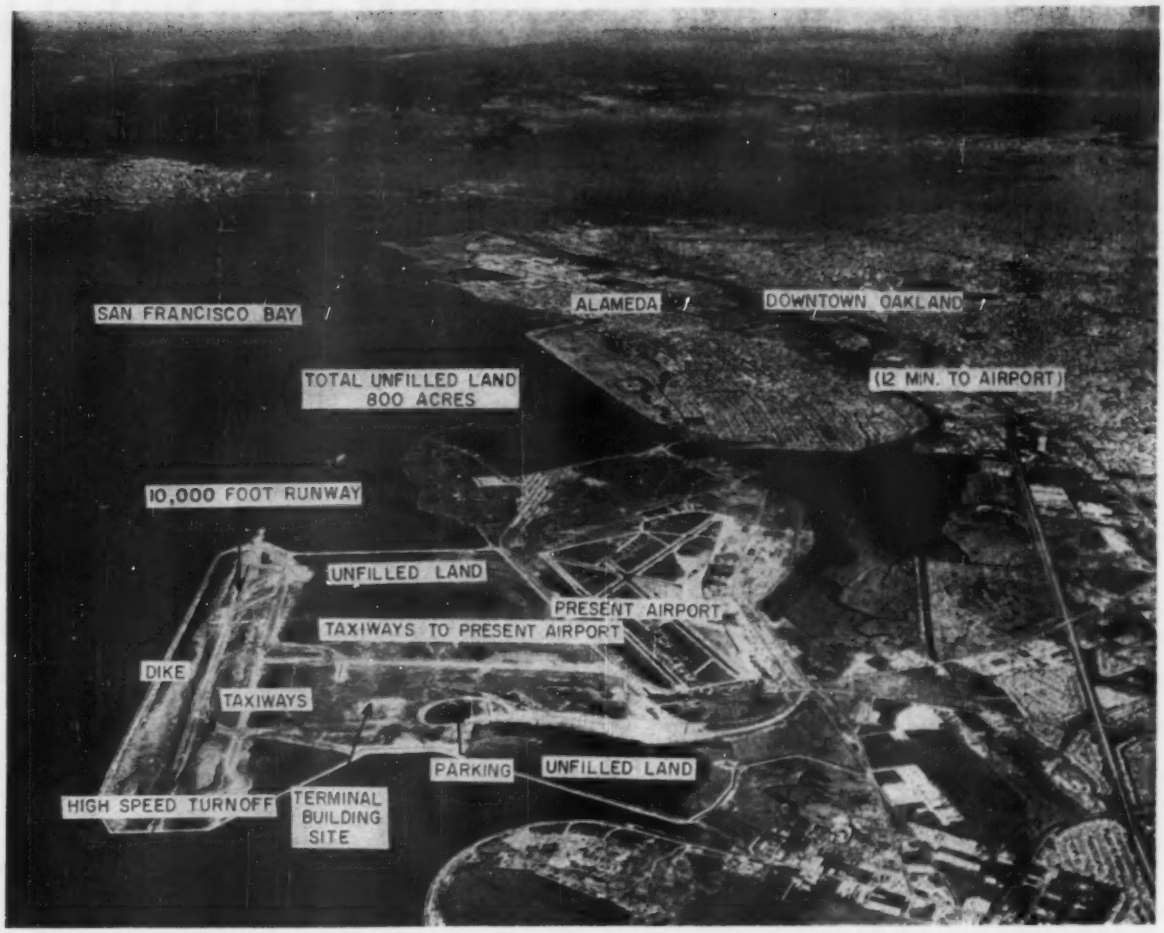
Route Realignment

In his letter to the Board asking for the route realignment, Capital President David H. Baker noted that the revision would give the communities involved "an opportunity of obtaining improved air transportation" while providing local service carriers with "enlarged traffic reservoirs."

Allegheny agreed that the program would be of substantial benefit both to Allegheny and the communities involved and listed 17 cities, all but four of which are now served by both carriers, which it wanted to take over.

Here are the Capital routes Allegheny wants:

- **Washington/Baltimore** to Rochester and Buffalo via Harrisburg/York, Williamsport and Elmira/Corning.
- **Buffalo to Pittsburgh** via Erie.
- **Toledo to eastern cities** now served by Allegheny.
- **Norfolk/Newport News** to New York via Washington, Baltimore and Philadelphia.



RUNWAY CONSTRUCTION and sites for possible expansion are detailed in this aerial view of Oakland, Calif., International Airport.

Oakland Seeks Airline Service Increase

Oakland, Calif.—Port of Oakland expects to award a contract for construction of a $4.75 million terminal building topped by an 11-story control tower as the nucleus of an expanded Oakland International Airport, a facility which will cover about 1,500 acres when work is completed in early 1962.

Meanwhile, Port of Oakland has engaged Cecil A. Beasley and the Washington, D. C., law firm of Henry Beecken & Associates to present a formal complaint to Civil Aeronautics Board on alleged inadequacies of service at the present Oakland Airport. The complaint will follow an informal conference with CAB officials on the subject, to be held within 60 days in Washington.

At Ontario, Calif., a survey conducted for the City of Ontario also criticized lack of scheduled service at Ontario's International Airport, calling five flights a day "grossly inadequate," but made no overtures to the CAB.

Oakland's talking point will be its $20.5 million "expansion" program, tantamount to construction of an entirely new airport. Although it is building one of the most advanced facilities for its size in the U. S., Oakland fears it will find itself in the position of "owning a big league ball park but no players."

Oakland officials complain that only one nonstop first-class flight is operating daily to Los Angeles at present, that no first-class flights operate nonstop to eastern points, and that several routes originate in Oakland but return to San Francisco, downgrading the value of the Oakland facility.

The Beecken firm and Beasley earlier were successful in pressing a similar complaint on behalf of the city of Baltimore, which subsequently won greater service for its Friendship Airport.

The new terminal building will front on a 10,000-ft. runway capable of handling the largest jets. The runway features high-speed turnoffs for incoming aircraft, enabling them to clear the runway faster by entering taxiways while still moving as fast as 60 mph.

The new runway and terminal building will be located on a 600-acre tract, reclaimed from the bay and filled, and protected from bay encroachment by a 12-ft.-high dike, 4.5 mi. in circumfence.

The runway points north-south and is located almost two miles out in the bay, minimizing jet noise, in contrast with San Francisco International, where housing developments have been built on marshland virtually to the edge of the runways. Oakland has had no experience with pure jets because the present facility can't handle them, but city officials are expecting no trouble because of the unique location of the new runway.

The single runway is pointed out as an example of current thinking which holds that intersecting runways are fast becoming obsolete in commercial flying. Aeronautical consultants to the Port of Oakland say that the single runway will handle 98% of all wind situations, and that the remaining 2% will concern smaller aircraft only. In

the event of high crosswinds these craft will be using the old intersecting Oakland landing strips.

The new runway and terminal building will handle regular commercial flights and any large military planes which may have to land at the facility. The older part of the airport will then be relegated to business and private planes and to civilian or military planes flying in for repairs or special maintenance. The old airport has extensive maintenance facilities.

About $7 million in federal monies already has been spent or committed to the expansion program. The balance of the $20.5 million is from Port of Oakland funds and special revenue bonds. About $3 million of the total will be spent for resurfacing of runways and for other improvements at the existing field.

Ontario Survey

Ontario's survey, conducted by Leigh Fisher & Associates, showed that nearly half of the more than seven million population in the Greater Los Angeles complex are closer in travel time to Ontario International Airport than they are to Los Angeles International during peak traffic hours.

The report, calling the present scheduling of five flights a day from Ontario "grossly inadequate," said a significantly large portion of the population could be better served by Ontario International than the Los Angeles airport.

The survey concentrated on showing the relative surface transportation times between various points in the counties of Los Angeles, Ventura, Riverside, San Bernardino, and Orange to both Los Angeles and Ontario International airports. Ontario Airport lies about 55 surface mi. east of Los Angeles International in the San Gabriel valley.

City of Ontario recently completed a new terminal building and the master plan, of which the Fisher report is a part, calls for runway extension and further terminal development. Ontario Airport presently is a primary diversion point for aircraft from Los Angeles International in the event of below-minimum weather because statistics show that 98% of the time, one or the other of the two airports is open.

The study group found that an air market division exists between the two airports of a complementary rather than a competitive nature, placing San Bernardino, Riverside, most of Orange County, and a substantial portion of eastern Los Angeles counties in closer travel time to Ontario than to Los Angeles Airport.

Ultimate answer to where the second major airport to serve the greater Los Angeles area will be located, however, must await the outcome of a survey of the problem on a regional basis. Los Angeles Chamber of Commerce has no disagreement with the survey conducted by Fisher for the City of Ontario.

But, the chamber announced recently that the need for a second airport by 1965 is recognized and a survey will be undertaken on a regional basis to determine where it will be located. The survey will be conducted on a regional basis to eliminate the possibility that local or county politics, or special interests will enter into consideration.

10 Trunklines Sign Voluntary Liquor Code

Washington—Voluntary liquor code governing the control of alcoholic beverage service on scheduled airline flights within the United States has been signed by 10 trunklines.

The agreement, which has been submitted to the Civil Aeronautics Board for approval, revises previous codes in that it now embraces the service of wines and beers as well as distilled beverages. Of the 12 trunklines, only Western Air Lines and United Air Lines are not signators to the agreement. Here are the essential features of the revamped code:

- **Service of alcoholic beverages** to any one passenger during continuous flight will be restricted to not more than the alcoholic equivalent of four ounces of distilled spirits, beer or wine.
- **Agreement defines alcoholic** equivalent of four ounces of distilled spirits in wine as 26 ounces and, in beer, as the contents of two 12-ounce containers.
- **In addition to such quantities,** a maximum of seven ounces of wine may be served with meals.

A previous agreement, which was signed by eight of the 12 trunklines, restricted the service of distilled liquor to one and one-half ounces but made no mention of wines or beers. The code will be enforced by the Enforcement Office of the Air Traffic Conference.

Several moves have been made in Congress during the past few sessions to eliminate liquor service on all scheduled airline flights.

Delta Opens Jet Overhaul Base at Atlanta

Delta Air Lines' recently-opened jet overhaul base at Atlanta Airport consists of three buildings covering 400,900 sq. ft. of floor space. Hangar area measures 48-ft. high by 420-ft. with a clear space depth of 170 ft. Approximately 1,600 persons are employed at the facility, where all phases of the carrier's airframe and engine maintenance and overhaul for Convair 880s and Douglas DC-8s will be handled.

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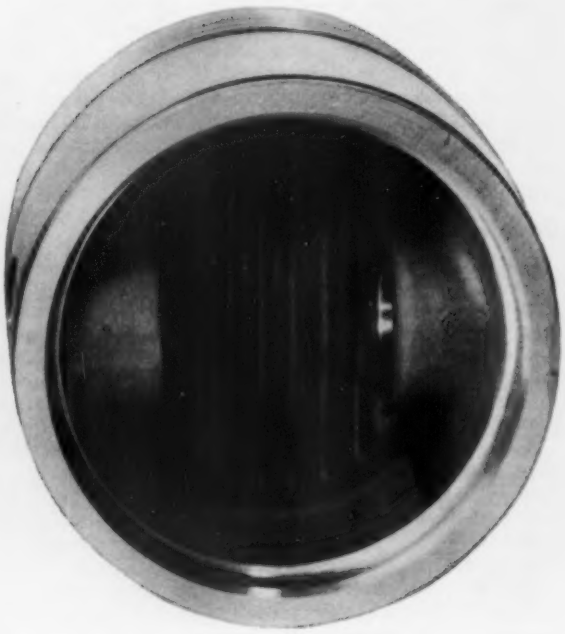

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American's First 720 Prepared for Service

First American Airlines Boeing 720 intermediate range jet transport is scheduled to start service July 31 between Cleveland, St. Louis and Los Angeles (AW July 11, p. 52). Company designation is 707-023. The aircraft is powered by four Pratt & Whitney JT3C7 turbojets, but the 720B, of which American has ordered 15, will be fitted with P&W JT3D turbofans (AW June 27, p. 45). The 720 features additional leading edge wing flaps for improved landing and takeoff characteristics (bottom photo) and a 41 ft. 6 in. tail, 3 ft. higher than the 707-120 tail. Wing area has been enlarged between inboard engine pylons and the fuselage (right), although wing span remains the same. This airplane, one of 25 ordered by American, eventually will be modified to the turbofan configuration. Carrying 98 passengers (48 first class and 50 coach), the 720 will cruise at 616 mph.; maximum altitude is 40,000 ft. and maximum range is 3,500 mi. United Air Lines put the 720 into service first, between Chicago, Denver and Los Angeles and Pacific Coast routes.

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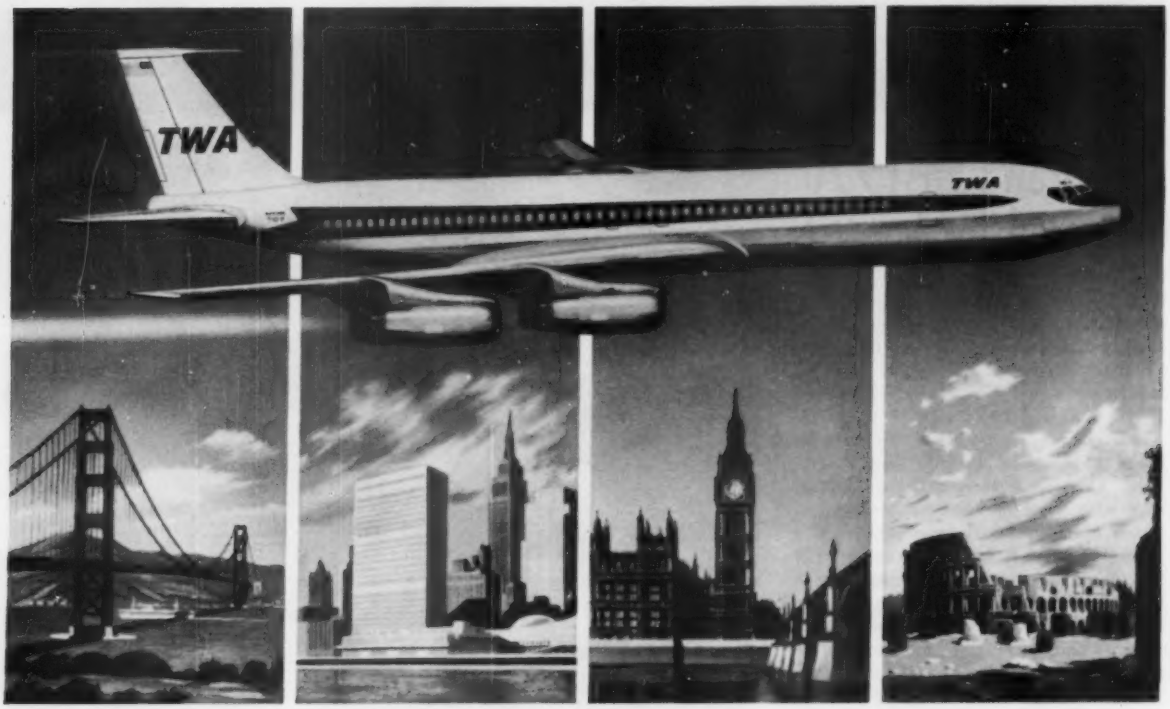

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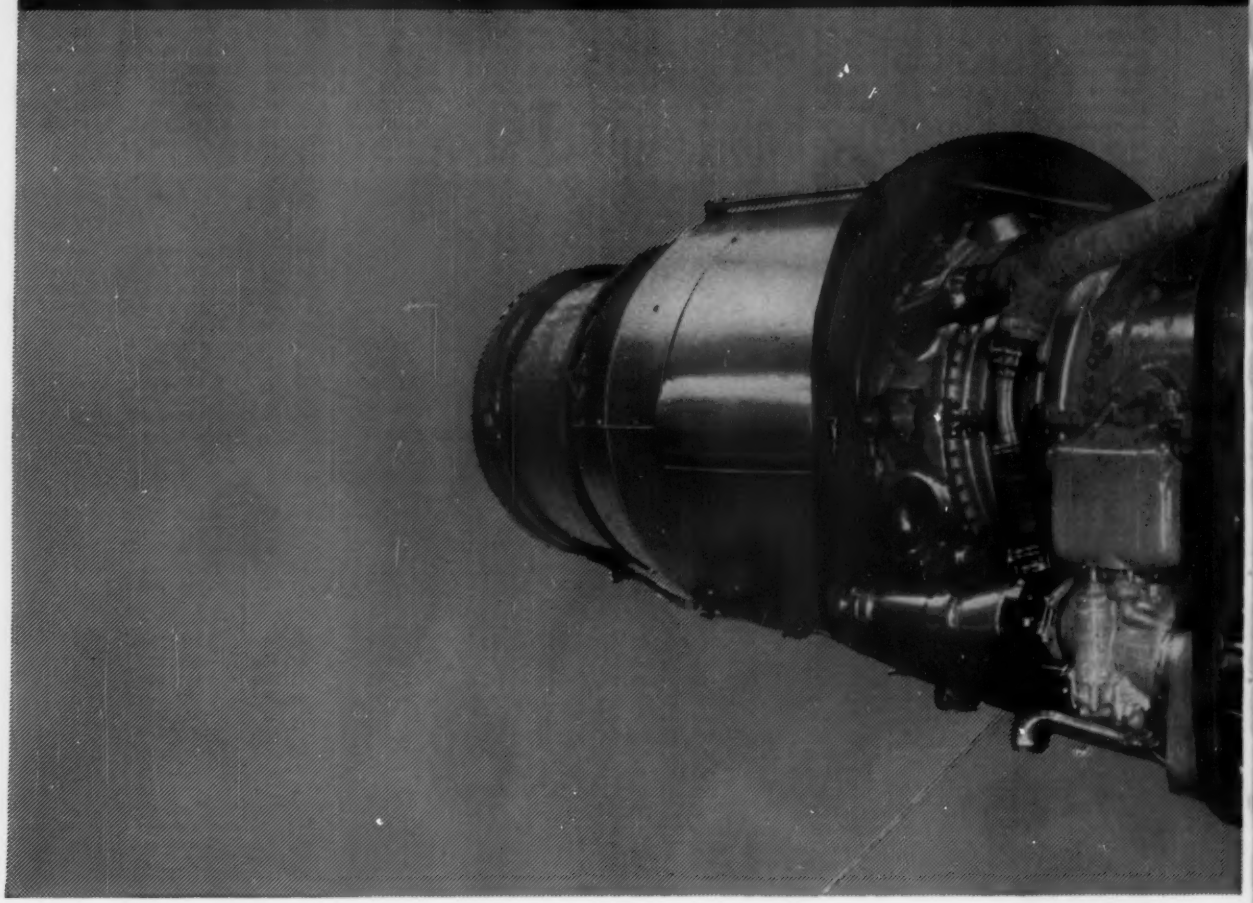
Airline Traffic—May, 1960

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNK								
American	717,711	531,949	65.5	1,835,952	917,225	8,868,461	62,659,272	57.2
Braniff	197,719	93,615	56.7	417,618	172,519	658,223	10,228,872	46.3
Capitol	319,480	129,947	52.4	567,515	270,371	486,433	13,774,136	48.2
Continental	113,284	73,069	46.7	175,862	115,186	361,322	7,665,083	38.1
Delta	289,986	154,166	61.0	418,876	285,372	1,326,019	16,849,828	50.6
Eastern	668,054	340,078	54.05	1,153,327	493,668	1,609,489	35,991,503	42.88
National	126,050	74,704	52.9	284,735	57,183	660,127	8,282,102	41.7
Northeast	117,790	43,255	48.40	113,113	34,880	232,187	4,520,239	42.36
Northwest	136,515	107,464	48.3	622,685	271,025	1,471,384	12,673,908	43.8
Trans World	440,214	373,836	63.7	1,429,677	666,563	3,275,271	41,193,702	52.3
United	654,872	449,862	63.9	2,929,295	976,197	6,192,966	53,259,502	55.8
Western	130,116	69,357	53.9	272,541	84,036	408,623	7,408,521	47.9
INTERNATIONAL								
American	7,859	7,927	49.3	9,129	329	242,717	1,071,928	54.8
Braniff	5,063	10,320	52.9	32,629	.....	126,684	1,286,113	46.8
Caribbean Atlantic	31,740	2,165	68.6	2,282	.....	8,533	238,542	72.8
Delta	2,507	3,629	39.9	6,306	.....	27,467	429,724	37.6
Eastern	41,586	59,976	59.23	126,346	.....	154,859	6,410,648	56.31
Mackey	10,294	1,631	38.5	.....	232	5,262	181,200	41.5
National	1,949	1,545	37.1	2,359	1,479	7,427	175,628	32.5
Northwest	16,133	28,953	47.4	1,187,518	17,116	928,213	5,215,331	50.7
Pan American								
Alaska	6,467	6,697	55.9	38,063	.....	190,578	931,859	54.9
Atlantic	128,731	175,519	69.4	1,319,492	.....	4,025,461	23,705,048	62.4
Latin America	83,563	103,886	62.0	414,707	.....	3,874,994	14,532,535	60.8
Pacific	34,694	120,602	68.9	1,873,453	.....	2,441,231	16,896,872	61.9
Panagra	9,689	14,375	50.2	81,749	.....	526,650	2,175,317	54.4
Resort	.....	.....	.....	.....	.....	3,368,579	3,368,579	79.3
Trans Caribbean	11,675	18,175	73.5	.....	.....	296,076	1,836,311	72.1
Trans World	40,437	114,208	70.1	1,135,722	.....	1,339,801	14,340,522	66.9
United	12,116	30,074	82.5	168,560	9,173	164,106	3,401,530	71.6
Western	4,580	7,112	65.6	8,624	.....	32,718	785,640	69.3
LOCAL SERVICE								
Allegheny	59,235	11,586	47.4	16,215	28,304	42,584	1,192,334	45.7
Bonanza	21,073	5,171	38.5	8,832	2,702	11,068	518,254	39.8
Central	15,249	2,912	40.0	8,893	3,792	11,740	303,783	36.5
Frontier	27,971	7,311	36.5	25,196	9,505	64,297	804,001	40.5
Lake Central	21,479	3,439	41.8	11,008	21,033	.....	361,555	46.3
Mohawk	51,541	10,225	48.0	16,233	16,624	17,378	1,025,909	44.6
North Central	81,315	14,182	43.12	39,433	39,517	40,473	1,494,896	44.18
Ozark	31,614	9,139	40.8	15,389	23,228	27,804	940,333	43.9
Pacific	44,338	10,131	50.7	17,501	4,087	7,446	995,562	45.8
Piedmont	41,826	8,919	47.8	13,799	15,907	19,409	903,578	49.0
Southern	30,883	5,600	33.7	18,851	14,603	19,554	589,823	35.4
Trans-Texas	28,524	6,745	40.0	21,927	11,746	36,831	715,802	40.8
West Coast	34,422	7,996	44.32	8,809	4,046	16,423	797,448	44.21
HAWAIIAN LINES								
Aloha	27,579	4,032	58.5	2,517	.....	7,895	333,537	53.0
Hawaiian	39,845	8,842	55.0	86,956	.....	346,699	1,237,755	54.2
CARGO LINES								
AAXICO	.....	.....	.....	.....	.....	6,545,558	6,545,558	65.7
Aerovias Sud Americana	.....	.....	.....	.....	.....	472,340	472,340	82.0
Flying Tiger	1,938	2,652	65.4	53,275	50,049	7,411,395	7,779,871	68.6
Riddle								
Domestic	.....	.....	.....	26,033	28,039	1,330,658	1,384,730	67.4
Overseas	.....	.....	.....	5,991	.....	481,974	487,965	67.5
Seaboard & Western	2,206	8,549	100.0	399,339	.....	3,221,504	4,494,479	65.7
Slick	1,919	6,642	100.0	.....	.....	6,563,956	7,227,370	100.0
HELICOPTER LINES								
Chicago Helicopter	29,348	501	50.7	1,331	.....	.....	49,207	42.5
Los Angeles Airways	3,523	123.9	59.0	5,210	2,432	.....	19,500	66.5
New York Airways	13,350	267	56.3	1,920	1,101	635	29,074	56.1
ALASKA LINES								
Alaska Airlines	10,797	8,690	59.3	76,656	6,978	382,751	1,321,935	66.2
Alaska Coastal	6,146	597	53.8	4,589	.....	6,062	71,756	54.4
Cordova	1,727	306	45.6	4,167	.....	58,621	94,320	49.2
Ellis	6,391	410	56.3	4,687	.....	6,990	54,359	74.7
Northern Consolidated	2,645	842	38.1	38,648	.....	62,903	192,551	56.5
Pacific Northern	11,936	11,134	55.9	115,052	7,364	320,434	1,652,551	67.6
Reeve Aleutian	1,903	1,611	42.0	39,062	.....	64,640	279,017	65.1
Western Alaska	293	25	71.7	573	.....	357	3,222	52.1
Wien Alaska	3,683	1,244	57.4	46,002	.....	119,735	292,759	53.0

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Latest Olympus version – ready for production



...ANOTHER ENGINEERING

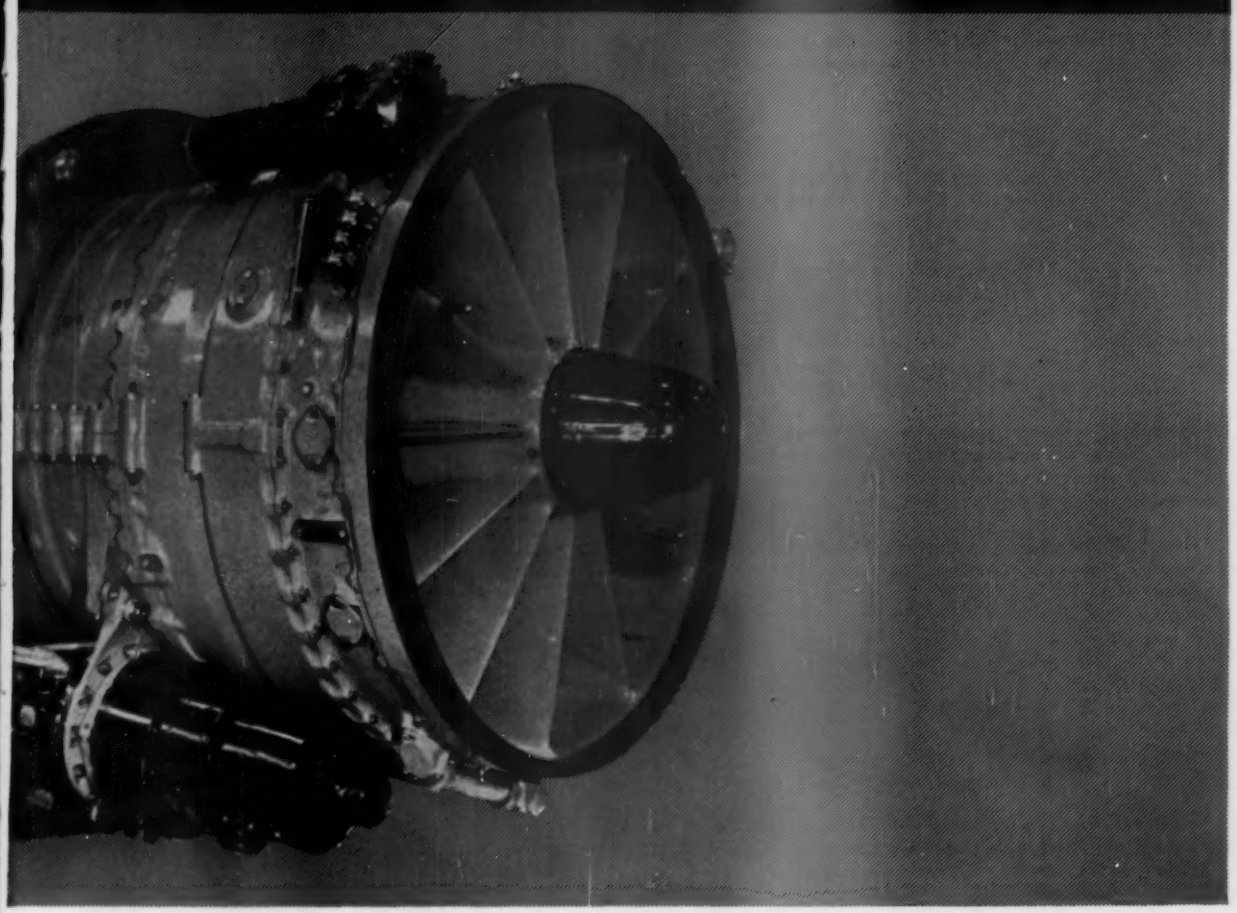
Security restrictions have just been lifted to permit the release of some details of the current Olympus version, the 21, which is now ready for production.

157-in long and with a 42-in intake diameter, the Bristol Siddeley Olympus 21 is Britain's most powerful military aero-engine. It inherits all the outstanding qualities of its forebears—high power at high altitude, unequalled handling characteristics, low fuel consumption and great operational flexibility. It also possesses the highest thrust/weight ratio of any high-thrust turbojet in the world.

The Olympus series of engines owes its excellent all-round performance to the two-spool compressor system, pioneered by Bristol Siddeley and since adopted by the leading aero-engine producers in Britain and the USA. Proof of Olympus reliability is given by the fact that it has the *longest achieved overhaul life*, the *lowest specific fuel consumption* and the *highest thrust* of any bomber or fighter engine in squadron service with the RAF.

The enormous development potential of the Olympus has repeatedly been proved. The first production version delivered 11,000-lb thrust dry, the current Olympus 21 has reached 20,000 lb, and an

produces 20,000-lb thrust dry...



ADVANCE BY BRISTOL SIDDELEY

even later version is rated at no less than 33,000 lb with reheat.

Olympus applications. The Olympus 201 already gives the Avro Vulcan B 2, spearhead of the RAF's V-bomber force, an all-round performance unsurpassed by any other aircraft of its type. The Olympus 21 has been designed to allow the Vulcan to reach its ultimate design potentialities.

The Bristol Siddeley Olympus is ideally suited to operation at transonic speeds and an advanced version has been selected to power the British Aircraft Corporation's TSR 2, a new tactical support/reconnaissance aircraft chosen for the RAF. Other Olympus versions are under active consideration for the next generation of civil airliners—the supersonic transports.

BRISTOL SIDDELEY ENGINES LIMITED

Bristol Aero-Industries Limited, 200 International Aviation Building, Montreal 3, Canada. Telephone: University 6-5471

AIRLINE OBSERVER

► Eastern Air Lines' new program of strict scheduling of flights according to traffic demands in place of the former policy of high-rate frequency scheduling has resulted in the withdrawal of 31 piston-engine aircraft from active service and reduction of the company's personnel force by about 1,000 employes. Program is already increasing load factors.

► Team of six experts from Douglas Aircraft Co. and Sperry Rand Corp. is starting a tour to brief airline service people on adjustment of the Sperry SP-30 autopilot in the DC-8, turbojet transport. Two cases have been reported on individual airplanes in which the aircraft on autopilot cruised in a slight, continuous roll. Using a line analyzer, Sperry found in the case of one, a KLM Royal Dutch Airlines DC-8, that the leads to the yaw and to the pitch axis accelerometers had been reversed. The directional gyro had been changed, and the possibility existed that polarity may have been reversed. The Douglas-Sperry team is now studying a similar problem in a Panagra DC-8. Federal Aviation Agency is not officially concerned since the autopilot is not a safety-of-flight item and the problem is not considered a hazard. The autopilot is a sophisticated design, and there is a possibility some redesign may be undertaken to simplify maintenance.

► Japanese government has approved a five-year expansion program for Japan Air Lines that will embrace inauguration of routes into Shanghai and Peking sometime during that period. Plan includes start of service to Europe and around-the-world flights.

► First congressional protest to the Civil Aeronautics Board proposal to eliminate competitive bidding by commercial airlines for military airlift contracts (AW July 11, p. 39) came from Sen. John Sparkman (D.-Ala.). Sparkman, in a letter to CAB Chairman Whitney Gillilland, charged that the proposed change would "make it virtually impossible for small airline carriers to participate in the MATS program of procurement. . . ." Also, Defense Department is showing no enthusiasm for the program. Deputy Secretary of Defense, James H. Douglas, told Gillilland he was "concerned that, coming at this time, a major revision in the Board's exemption policy . . . would seriously interfere with our efforts to achieve the objectives of" the revised procurement program now being developed by MATS.

► Proximity warning indicator which uses existing airline weather radar plus a modest-size black box adapter developed by Radio Corp. of America will start flying the line in a United Air Lines Convair 340 before the end of the month to evaluate its performance in daily operations. Initial experimental tests (AW Apr. 18, p. 52) to date appear encouraging.

► Piedmont Airlines has joined the Assn. of Local Transport Airlines to bring local service airlines membership to nine. Mohawk Airlines recently resigned from the organization.

► KLM-Royal Dutch Airlines is offering a new 15-year 5% bond issue in the amount of $13.1 million for the purchase of new aircraft. Bonds, which will be listed on the Amsterdam Stock Exchange, are being offered in the Netherlands at 100% of par through a Dutch underwriting group. No decision has been made on the type of aircraft to be purchased to supplement KLM's 12 DC-8s and 12 Lockheed Electras on order.

► Railway Express Agency is looking for a new name that will more aptly describe its world-wide express services by all modes of transportation.

► Doppler adapter for weather radars, which would enable them to provide ground speed and drift information that now requires use of separate doppler radar, has been developed by Technical Research Group, Inc., Syosset, N. Y. Originally developed for military use to permit interceptor fire control radars to also serve as doppler navigation aids, the adapter is expected to weigh about 25 lb. and sell for less than $10,000. Federal Aviation Agency is reportedly following development. Company says that accuracy of ground speed and drift information obtained would be comparable to that provided by separate doppler navigation radars.

SHORTLINES

► **Alitalia,** the Italian state airline, reports a $245,803 net profit in global 1959 operations after taxes and charges of $6,198,424 to depreciation. In the carrier's annual report, it was announced 1959 operations ran at a 55% over-all average load factor. Broadening of public ownership in the airline, which is presently controlled by Instituto per la Ricostruzione Industriale (IRI), the Italian government holding company, was also announced at the annual meeting. More than $16 million worth of 5½% 20-year convertible debentures have been issued by the Italian airline.

► **Air Transport Assn.** motion to quash a subpoena from the Civil Aeronautics Board to produce certain records of the association has been denied by the Board and Air Transport Assn. has been ordered to produce the records within five days from the date of the order.

► **Braniff Airways** is offering gift certificates for air travel for any amount in excess of $10 which a passenger may exchange for, or apply toward, a ticket on any Braniff flight.

► **British European Airways** has begun construction of its $10 million passenger terminal in downtown London. The 10-story terminal, located in Cromwell Curve, West Kensington, will contain reservations, sales and office space for BEA offices now scattered throughout London.

► **Flying Tiger Line** has received a $462,000 three-month fixed contract from Military Air Transport Service to operate Lockheed Super H Constellation service from Honolulu to several islands in the Pacific area. Service calls for twice-weekly flights from Hawaii to Johnson Island, Kwajalein and Eniwetok Atoll and return and four monthly round-trip flights from Honolulu to Johnson Island direct.

► **Iranair,** the Iranian state airline, has named Scandinavian Airlines System as its general sales agent in North America and northern Latin America. Iranair operates routes extending from Europe, through the Near and Middle East and into Asia.

► **Purdue Aeronautics Corp.** has been recommended for a certificate of public necessity to operate as a supplemental air carrier by a Civil Aeronautics Board examiner. The carrier would have operating rights within the continental United States.

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WESTERN AIRLINES

Ablation Wins Missile Performance Gain

By Michael Yaffee

Significant new advances in materials technology, the result of urgent military demands, are beginning to pay off in the development of missiles with greater speed, payload capability and lower radar cross-section.

Nike Zeus, the Army's anti-intercontinental ballistic missile weapon, is being completely covered with an ablating fluorocarbon plastic heat shield. New reinforced plastic ablating nose cones are being developed for smaller Army missiles such as the Pershing to increase their allowable speeds and to minimize possibilities of detection and interception.

Titan ICBMs will be equipped with Avco Mark IV ablating re-entry vehicles which have metal honeycomb-reinforced ceramic nose caps over metal backup structure. Mark V, the Minuteman re-entry vehicle now under development, will probably be of the same type of construction. New Mark IV and Mark V vehicles will come in on target much faster than the original copper heat-sink re-entry vehicles first developed for Titan and Atlas.

Larger Warhead

Some future Atlas ICBM squadrons will also be equipped with Mark IV re-entry vehicles. First operational Atlas squadrons, however, will use Mark III re-entry vehicles with ablating reinforced plastic heat shields to carry the nuclear warhead for which they were originally designed. Stronger Mark IV's will enable them to carry heavier warheads.

Improved Titan II (AW June 27, p. 34) will have a re-entry vehicle that can carry a still larger nuclear warhead. Fabrication of this vehicle, the Mark VI, is expected to follow the present practice of covering a metal substructure with a molded, ablating heat shield of reinforced plastic or reinforced ceramic. Newly developed, unreinforced epoxy plastics are also a distinct possibility for the heat shield of the Mark VI and even more likely for the heat shield on the Douglas Skybolt re-entry vehicle. The Skybolt re-entry vehicle is under development and proposals on the Mark VI are now in Air Force hands.

The Navy is sponsoring extensive development on pyrolytic or oriented graphite structures presumably as heat shields for an advanced Polaris IRBM re-entry vehicle. But some scientists believe that successful operational graphite nose cones are still some time off, particularly for present and future ICBMs with their more severe re-entry requirements.

Even farther removed from the operational stage is the work recently undertaken on transpiration cooling of re-entry vehicles which the Army is sponsoring as part of its study on re-entry physics. The first service to develop an operational ablating re-entry vehicle (for the Jupiter IRBM), the Army now finds itself more deeply involved than ever in nose cone material problems, principally as a result of its anti-ICBM work.

BLUNT, low temperature ablation heat shield, developed by Avco under Air Force contract, is made of Avcoat, a thermosetting plastic that starts to vaporize at 350F. Same material will be used on aft sections of Mark IV re-entry vehicle where aerodynamic is less severe than on the nose.

Ablating Materials

The Air Force, which for the sake of expediency took the blunt heat sink approach originally, now has definitely committed itself to the ablation technique for its several ballistic re-entry vehicles. Through its two principal subcontractors in this field, Avco and General Electric, the Air Force will employ a variety of ablating materials on its different re-entry vehicles, including straight plastics, fiber-reinforced plastics, metal-reinforced ceramics and plastic-impregnated ceramics.

Both General Electric and Avco are constantly developing new ablation materials. Sometime within the next few weeks, the Air Force will fly another re-entry test vehicle in an effort to determine the effectiveness of their newest formulations. In the case of General Electric, the materials trend now appears to be in the direction of pure plastics, while Avco is favoring the com-

posite metal-reinforced ceramic and fiber-reinforced plastic materials.

In the development of the first ICBM ablating re-entry vehicle, the Mark III, General Electric used a reinforced plastic heat shield over a metal backup structure. The resultant re-entry vehicle proved more than adequate for delivering the payload originally assigned to the Atlas, the company says. It now is being used at Vandenberg AFB, Calif. The Mark III also is slated for use on the three Atlas squadrons to be located at Warren AFB, Wyo., and the first Atlas squadron at Offutt AFB, Neb. There is also a possibility, the company adds, that it will be used on the first Atlas squadrons at Fairchild, AFB, Wash., and Formes AFB, Kan.

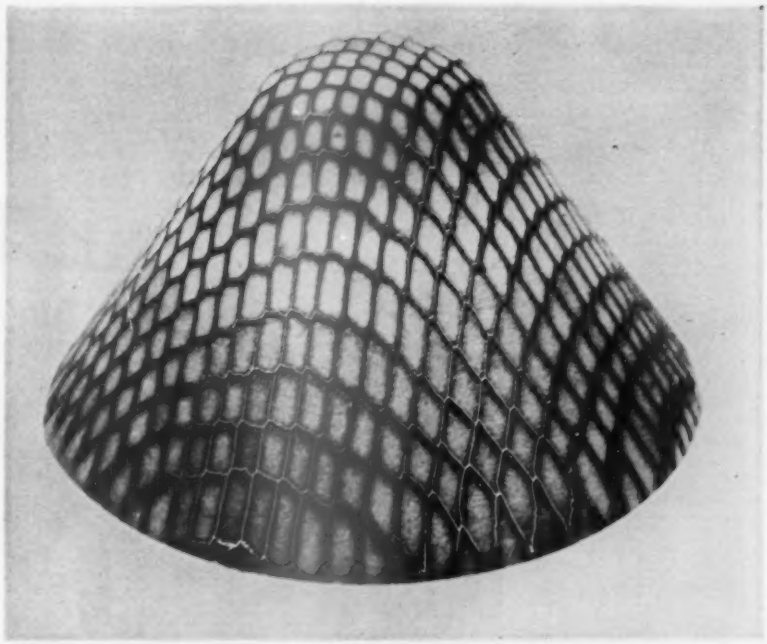
The Mark III, however, is not strong enough to carry the larger nuclear warheads which were originally assigned to the Titan and now also destined for some Atlas squadrons. With Avco's Mark IV re-entry vehicle soon to be available for the bigger warheads, General Electric feels there is no point in trying to redesign the Mark III for the Mark IV's job and will probably "leapfrog" both the Mark IV and Mark V (the Minuteman re-entry vehicle under development at Avco).

Skybolt Contract

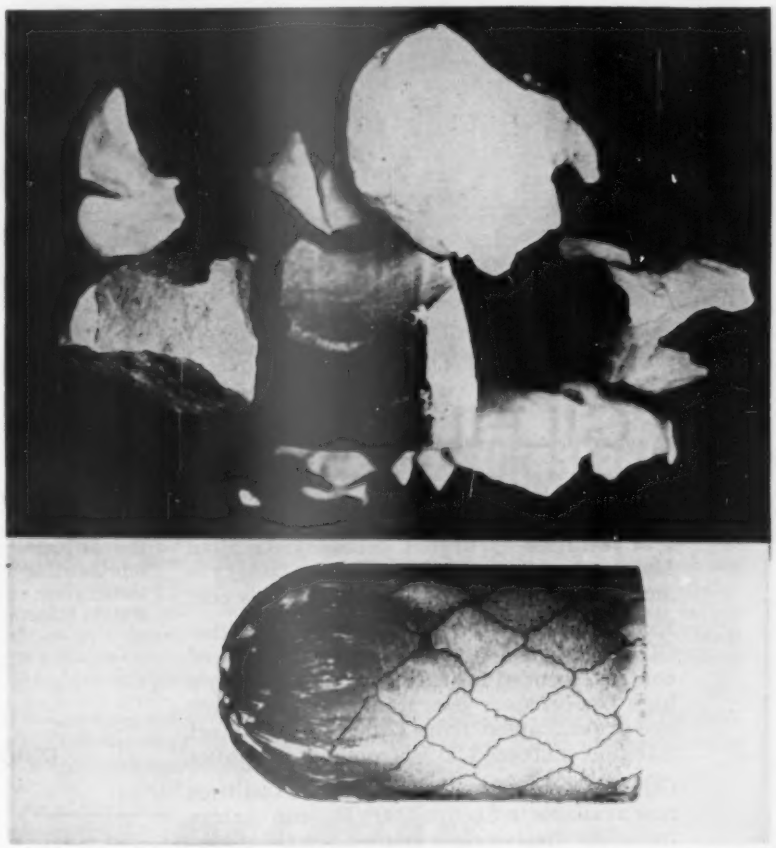
In addition to its present production contracts, General Electric now has the development contract for the Skybolt re-entry vehicle. The company also has submitted a proposal for the Titan II Mark VI re-entry vehicle. It is principally with these two projects in mind that GE's Missile and Space Vehicle Department is pursuing the development of its new epoxy plastic formulations. As far as missile re-entry vehicles are concerned, GE says it definitely is "going down the plastics trail," although it is also one of the companies now doing work for the military on transpiration cooling and pyrolytic graphite. (Among the others involved in pyrolytic graphite work are Raytheon and High Temperature Materials, Inc.)

General Electric's new epoxy plastics are called the Century series. The latest formulation in this series is GE 500. Essentially, these are clear, moldable, unreinforced plastics and would be used over a metal substructure in a fashion similar to that of the current reinforced plastic heat shields.

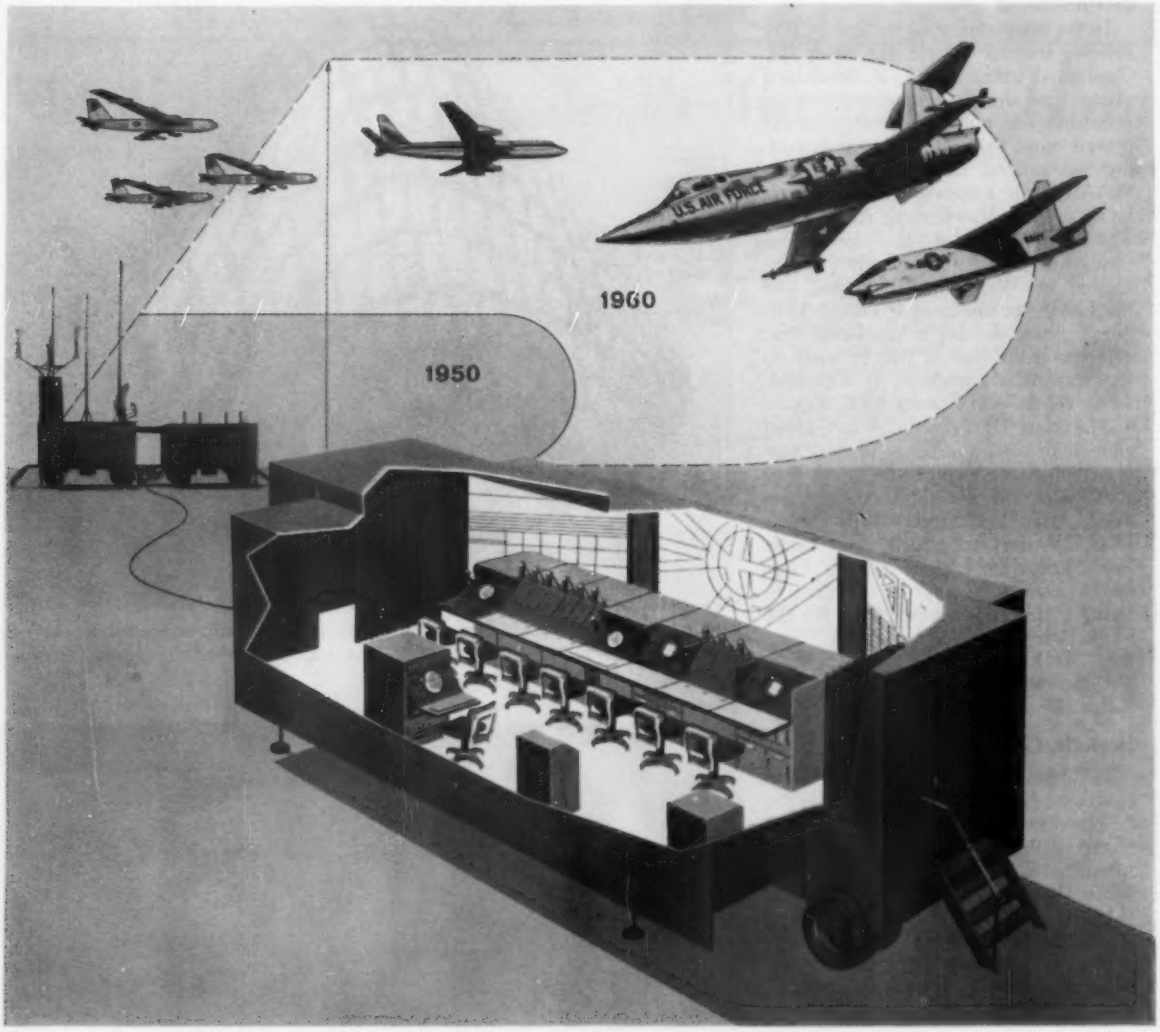
These materials have survived temperatures up to 20,000F for periods up to 10 sec. GE says they are easier to fabricate and less expensive than the reinforced plastics. Like the Army, General Electric investigated ceramic materials for possible re-entry applications and rejected them for essentially the same reasons: the com-



HIGH temperature ablation heat shield of the type that will be bonded to the nose of Avco's Mark IV re-entry vehicle is made from a metal honeycomb-reinforced ceramic that begins to ablate at 3,000F.



UNDER TEST in a plasma jet, unreinforced ceramic re-entry structure (shown at top) failed apparently due to thermal shock. Reinforced with metal honeycomb, same ceramic material (shown at bottom) which is probably silicon dioxide, successfully survived under the same conditions.



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parative dearth of information concerning ceramic technology, fabrication and bonding problems, the material's sensitivity to thermal and mechanical shock, and the difficulty in handling and working large ceramic nose cone structures.

Avco, on the other hand, saw the same problems but decided that the potential of ceramics could justify the trouble entailed in trying to solve them. Then, in 1959, the company's Research and Advanced Development Divsion announced the development of Avcoite, a metal honeycomb-reinforced ceramic which it credits as a major breakthrough that made the Mark IV re-entry vehicle possible.

Plastic Shields

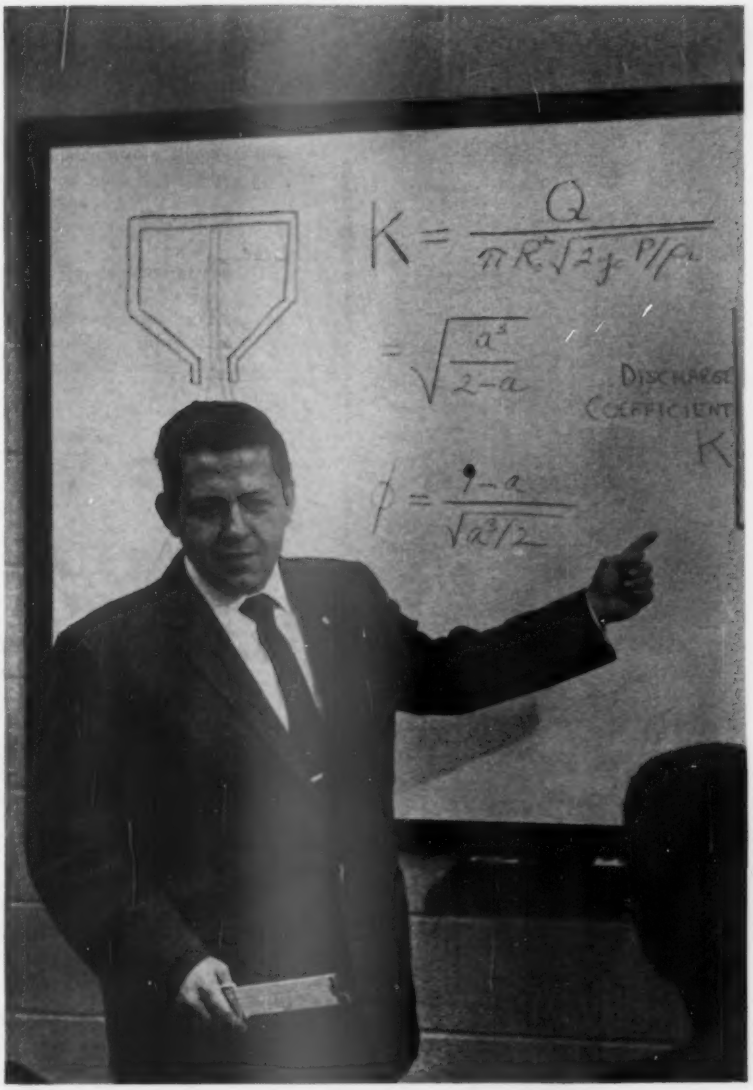
New operational Mark IV re-entry vehicles now going into production at Avco's Lycoming plant in Stratford, Conn., will employ ablating Avcoite nose caps, bonded to a metal backup structure. Cylindrical and flare sections of the Mark IV, where re-entry heating is less severe, will use reinforced plastic heat shields over the metal substructure.

Mark V, the Minuteman re-entry vehicle under development here, probably will follow the same form of construction, using essentially the same materials. Shape, material arrangement, thickness and other dimensions of the Minuteman heat shield, however, may differ. Mark VI, re-entry vehicle for the improved Titan II, will also probably have the same basic type of reinforced ceramic-plastic heat shield, if Avco eventually gets the contract.

In the case of the Mark IV, the three different materials used for the heat shield are Avcoite, Avcoat and RAD-58. Although Avco refuses to say exactly what its materials are, Avcoite is believed to be essentially a silicon dioxide (silica) ceramic; RAD-58, a plastic-ceramic composite of phenolic-impregnated silica; and Avcoat, a more conventional reinforced plastic, possibly of the glass fiber-reinforced epoxy type.

At present, Avco is fabricating seven versions of the full scale Mark IV re-entry vehicle which are designated Mark IV Mod. 1, Mark IV Mod. 2, etc., depending upon their destined application. One modification number, for example, is made for training purposes; another (unspecified) is destined for operational use, and still others, as in the case of the subscale RVX-3 and -4 test vehicles (AW June 6, p. 33), will be used for further development work, in some cases flying with different arrangements and thicknesses of the three heat shield materials.

Composition and arrangement of the operational Mark IV heat shield are now believed to be definitely established by Avco and Air Force scien-



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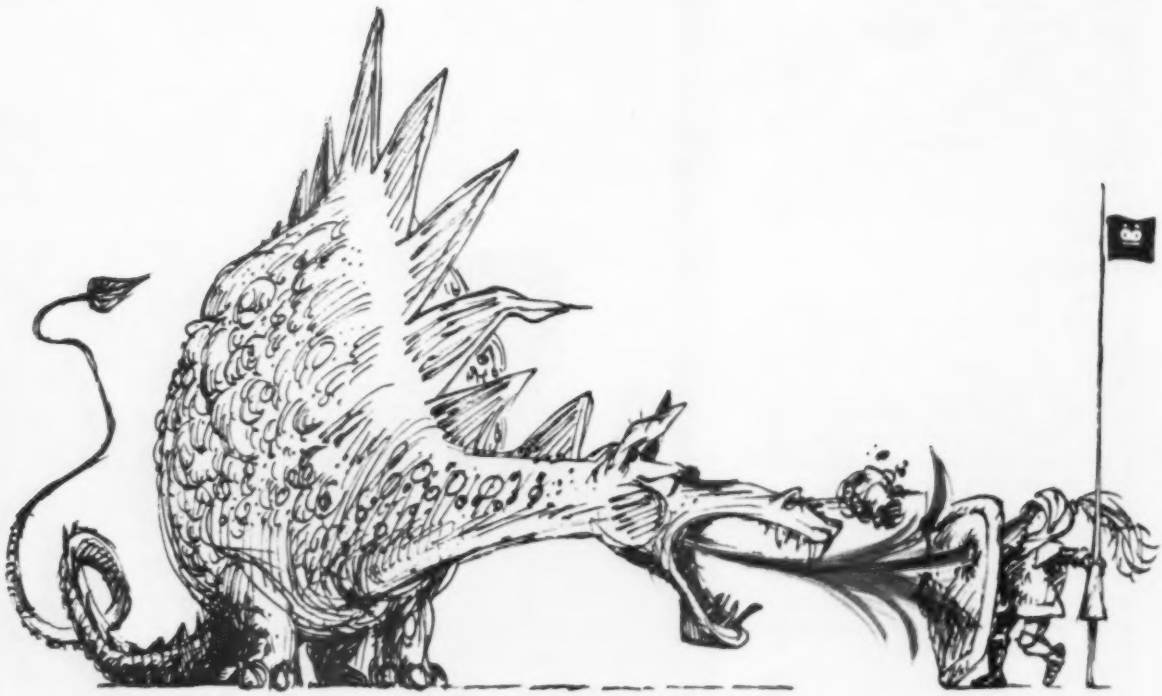
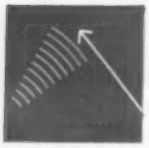


countermeasures problems?



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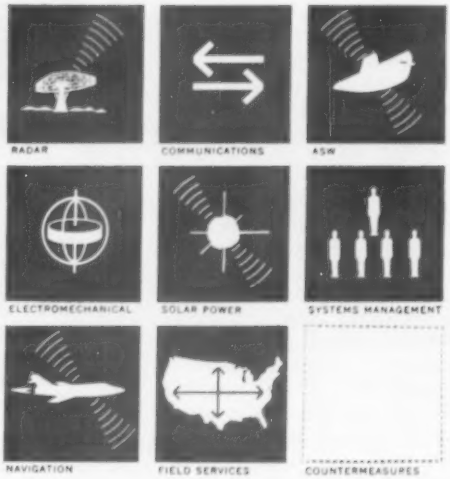

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Nozzle Work Aided Ablation Research

Ablating re-entry vehicle design derives in large measure from the work carried out on the aft end of the missile, the exhaust nozzle.

In September, 1956, Army fired the first ablating re-entry test vehicle to be designed for a U. S. military missile. Army became interested in the possibilities of ablation materials for this purpose as the result of the work it was doing on liners for rocket nozzles. (This is still an important program as far as the Army is concerned in that improvements continually are being made in the ablative, reinforced plastics that line practically every Army missile.)

From theoretical studies and laboratory test, Army decided in mid-1956 that ablation could handle the job on the Jupiter IRBM re-entry vehicle and also on the ICBM re-entry vehicles, despite the fact that the latter would travel at approximately twice the velocity of the former and have approximately four times as much kinetic energy to dissipate. Consequently, at this time, Army recommended the ablation approach to the Air Force.

The firing of the first ablating re-entry test vehicle enabled Army scientists to correlate theoretical and laboratory results with actual flight data. By mid-1957, Army had fired enough test vehicles to be convinced that ablation was the proper technique for both IRBM and ICBM re-entry vehicles. In May, 1958, Army fired the first full scale Jupiter re-entry vehicle and, later that year, delivered the first tactical Jupiters with ablating re-entry vehicles.

Ceramics was one of the first materials the Army Ballistic Missile Agency and its contractors investigated (AW May 12, 1958, p. 52). Fabrication and structural problems led them to the use of plastic binders for holding the ceramics together. They then decided that the plastics offered better physical and mechanical properties than the ceramics. With reinforcing agents and development of a suitable aerodynamic shape, the Army found that the plastics made successful heat shields. Army now has definitely cast ceramics aside in favor of reinforced plastics.

Believing that it would take too long to overcome all the obstacles in the development of ablating re-entry vehicles, the Air Force, for the sake of expediency, committed itself to the heat sink approach. By 1958, General Electric and Avco were well along in the development of heat sink re-entry vehicles for the Atlas and Titan. These vehicles consisted of a blunt front end fabricated from a predominantly copper alloy and a conical afterbody, which in the Titan vehicle was to be machined from beryllium.

General Electric had begun to deliver operational Mark II heat sink vehicles for the Atlas and Thor and Avco had moved its Titan re-entry vehicle program (a later development) to Stratford for production when, in August, 1958, the Air Force directed these companies to produce ablation re-entry vehicles. Both companies had been doing prior Air Force-sponsored research on ablation, and, as a result, the first General Electric ablating RVX-1 (RVX-1 and RVX-2 were re-entry test vehicles for the Mark III; and RVX-3 and RVX-4, for the Mark IV) was launched in January, 1959. Avco delivered the first RVX-3 in May 1959.

General Electric's production of the operational heat sink re-entry vehicles, Mark II Mod. II, ended only this year. These vehicles are in operation with four RAF Thor squadrons in England and on some Atlases at Vandenberg AFB. Some of the first Mark II's, in fact, are now starting to come back to GE's Burlington, Vt., plant for inspection and overhaul.

tists, although neither group will give details. Nevertheless, it appears certain that Avcoite will be used over the metal nose backup structure where the aerodynamic heating is the greatest, with RAD-58 and Avcoat going over the cylinder and flare sections.

As used on the Mark IV nose shield, Avcoite consists essentially of a metal reticulum in which the several, small, diamond and rectangular-shaped pockets formed from the honeycomb are filled with ceramic. Due to particular ablation requirements, each ceramic pocket on the rounded nose lies perpendicular to the outer surface. At approximately 3,000F, the ceramic starts to soften and, during re-entry, flows back to about three quarters the length of the cylindrical section, dissipating almost 90% of the aerodynamic heat in the process.

The remaining re-entry heat will be dissipated by the ablation of the Avcoat and RAD-58 coatings. Avcoite, Avcoat and RAD-58 actually represent three different families of materials, and Avco scientists are continuing to develop and refine formulations and fabricating techniques within all three groups. In Wilmington, Mass., for example, Avco's Research and Advanced Development Division, under contract from the Air Force, recently made a large blunt casting of Avcoat for consideration as a possible heat shield for the nose of some future, manned re-entry vehicle which would face less

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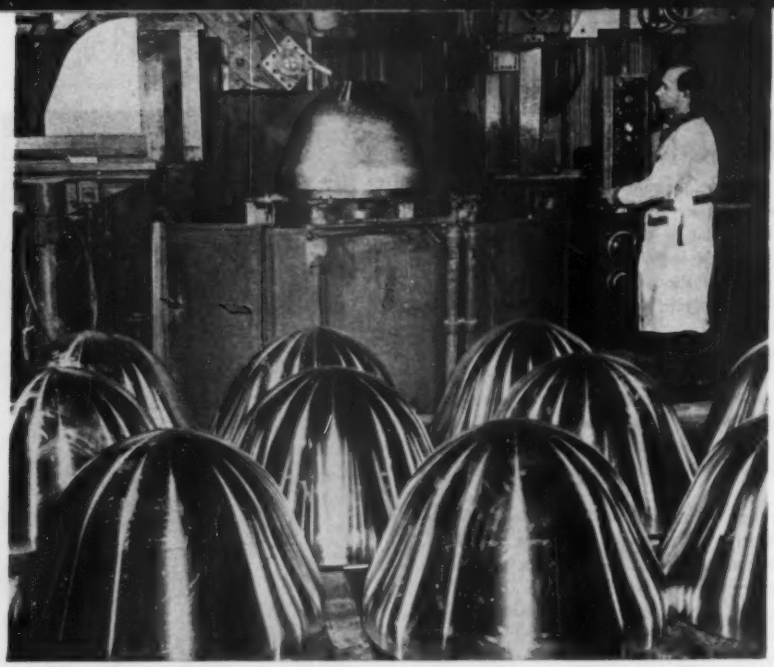
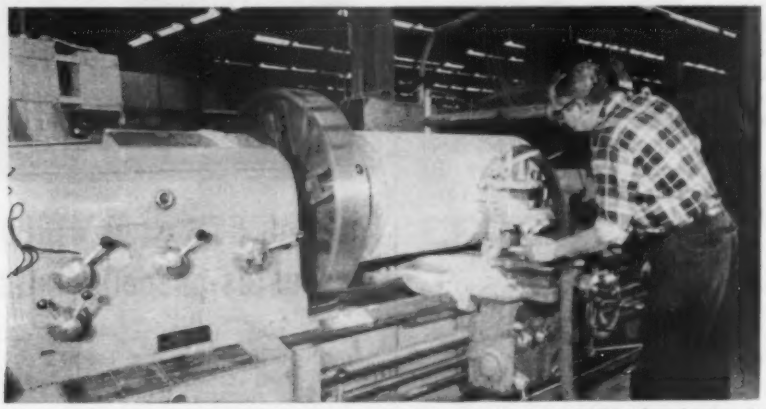
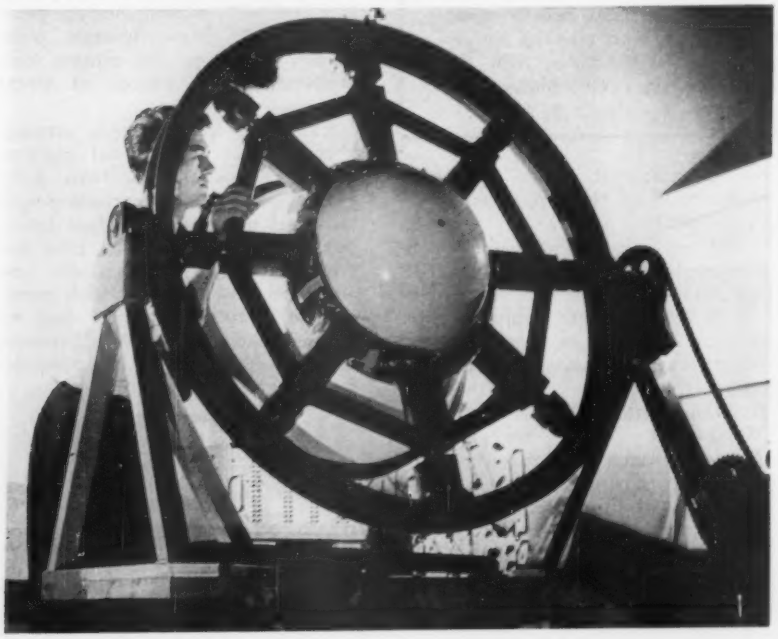


MAGNESIUM backup structure for Avco Mark IV re-entry vehicle is being contoured.



AVCO technician contour-grinds the Mark IV cylinder section heat shield (above). Avcoite nose cap (below) is mounted in handling fixture for inspection.



severe heating problems. This thermosetting Avcoat, Avco says, does not melt or char but partially vaporizes at 350F and therein dissipates heat.

Good as plastics such as Avcoat are for protecting recoverable type re-entry vehicles under conditions of predominantly laminar flow and relatively low heat fluxes, Avco felt they would be inadequate for the severe shear forces, turbulence and heat fluxes that the company expected to encounter on its new ablation type ballistic re-entry vehicles.

High Temperature Ceramics

From theoretical studies and experimental work, Avco scientists concluded that the high temperature ceramics such as alumina, magnesia, silica and beryllia were the best suited to the job now at hand.

In addition to the low thermal conductivities of the plastics, the ceramics offered higher heats of decomposition and vaporization.

Unlike plastics, however, the ceramics suffer from poor thermal and mechanical shock resistance and, consequently, might readily break in handling or spall in flight. The brittleness of the ceramics also gave rise to serious design and fabrication problems.

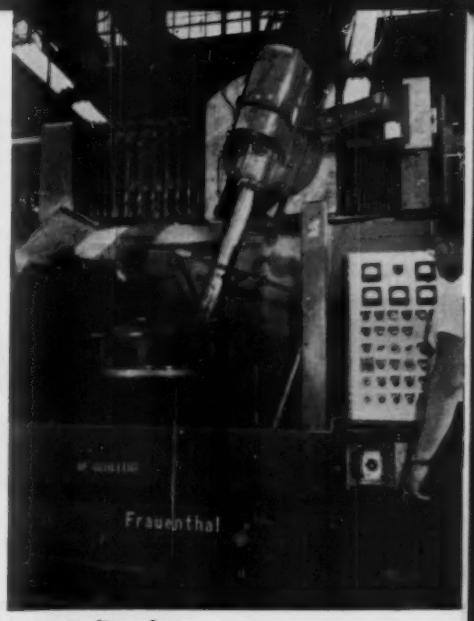
The fabrication of a monolithic ceramic re-entry structure, although desirable in some ways, was ruled out owing to the great weight and thickness of material that would be required.

On the other hand, Avco scientists reasoned that the allowable stresses could be increased and fracture and spalling localized if the ceramic re-entry structure were built in small pieces on a tide design.

Composite Structures

The small cross-section of the tile units, however, created problems in bonding and fabrication. These factors led Avco to the study of various composite ceramic structures using metal reinforcement in the form of wire, impregnation, and honeycomb. The honeycomb proved the most successful in improving thermal shock resistance and mechanical design properties of the ceramic. Moreover, Avco says, the fabricating process in which a standard metallic honeycomb is filled with a ceramic is both commercially feasible and versatile. Starting with the fabrication of small flat plates, technicians graduated in turn to curved panels, nozzles and cones. In the process, they developed methods of bonding and fastening.

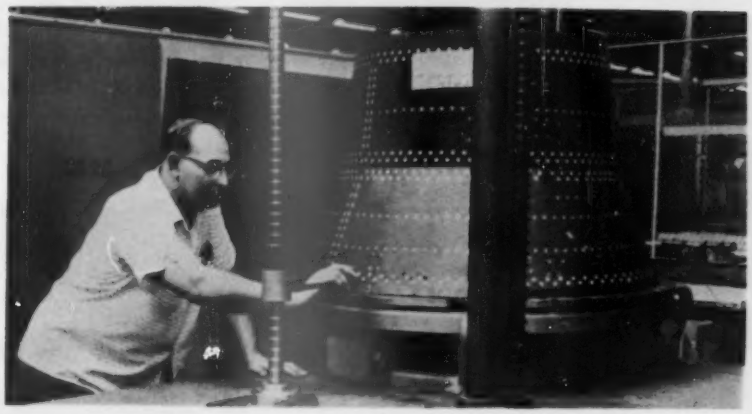
Theoretically Avcoite would lend itself to a number of ceramic fabrication processes. Avco will not divulge which of the processes it is actually using. But various fabrication characteristics,



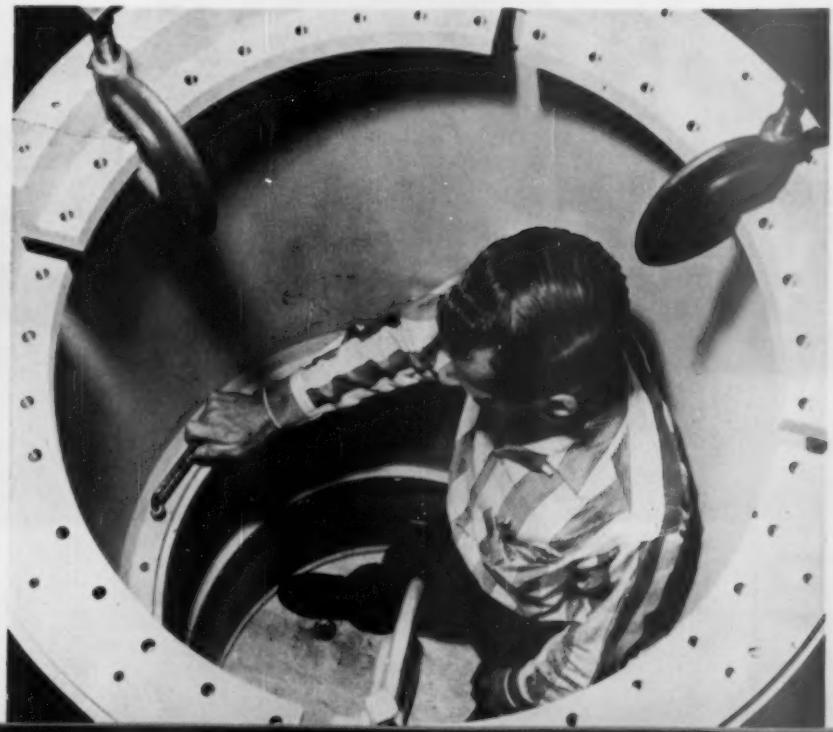
SPECIAL machines are used to grind Titan nose. Grinding arm (left) maintains preset angle to center line of cone.

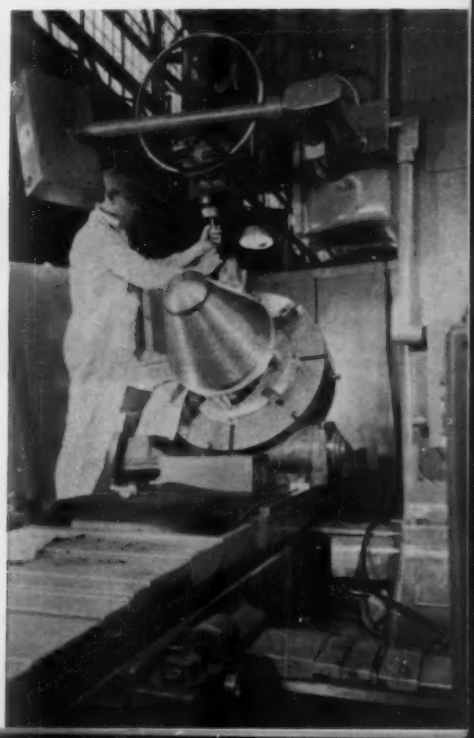
particularly the high densification of the material—up to 98% of true density, strongly suggest the use of hot pressing rather than the more common techniques such as slip casting.

In regard to fabrication, a technique recently developed by Marquardt's Samuel Sklarew under Air Force sponsorship for making reinforced refractory coatings could prove of interest. In this process, flexible metal strips corrugated in the form of a sine wave are fastened around a form longitudinally, horizontally, or even in a spiral. The ceramic, in the consistency of stiff dough, is trowled over the strips, finished and dried. Although the process was devel-



METAL backup structure for flare section is inspected (above). Two parts of cylinder section are mated (below, left). Nose of the earlier RVX-3 vehicle is shown at the lower right.





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Scheduled for fleet delivery in 1961, the all-weather Kaman HU2K "SEASPRITE" was developed to meet *high-performance* requirements of the U. S. Navy. Working closely with Kaman design engineers, Republic Steel is supplying light gage titanium and stainless steel for the HU2K.

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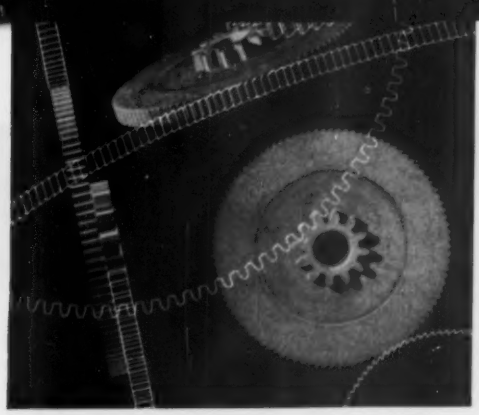

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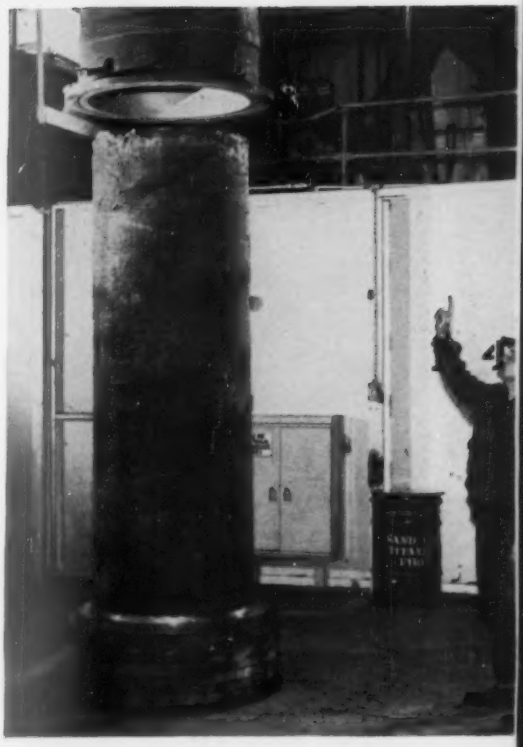

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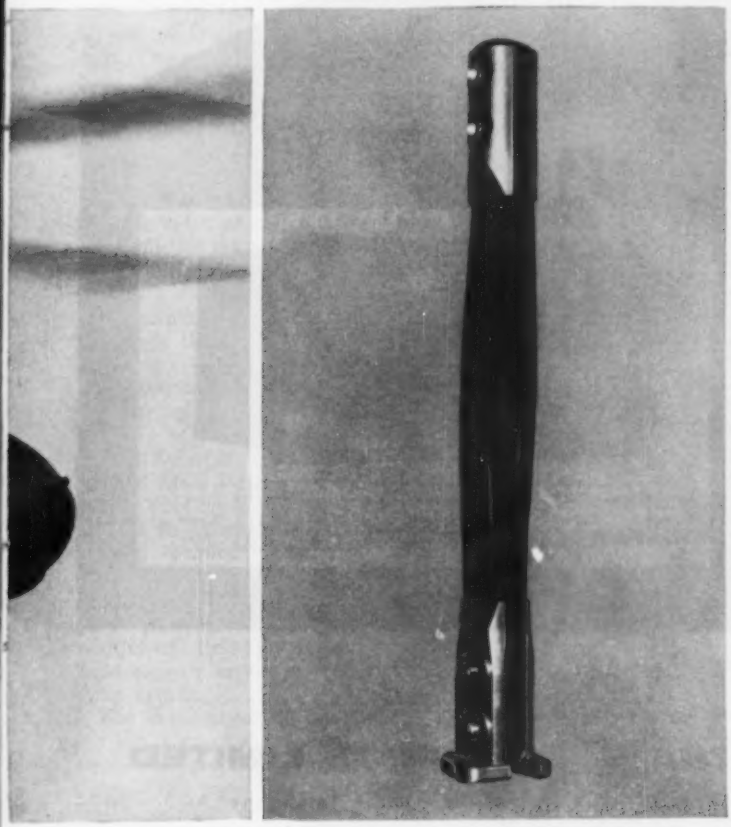

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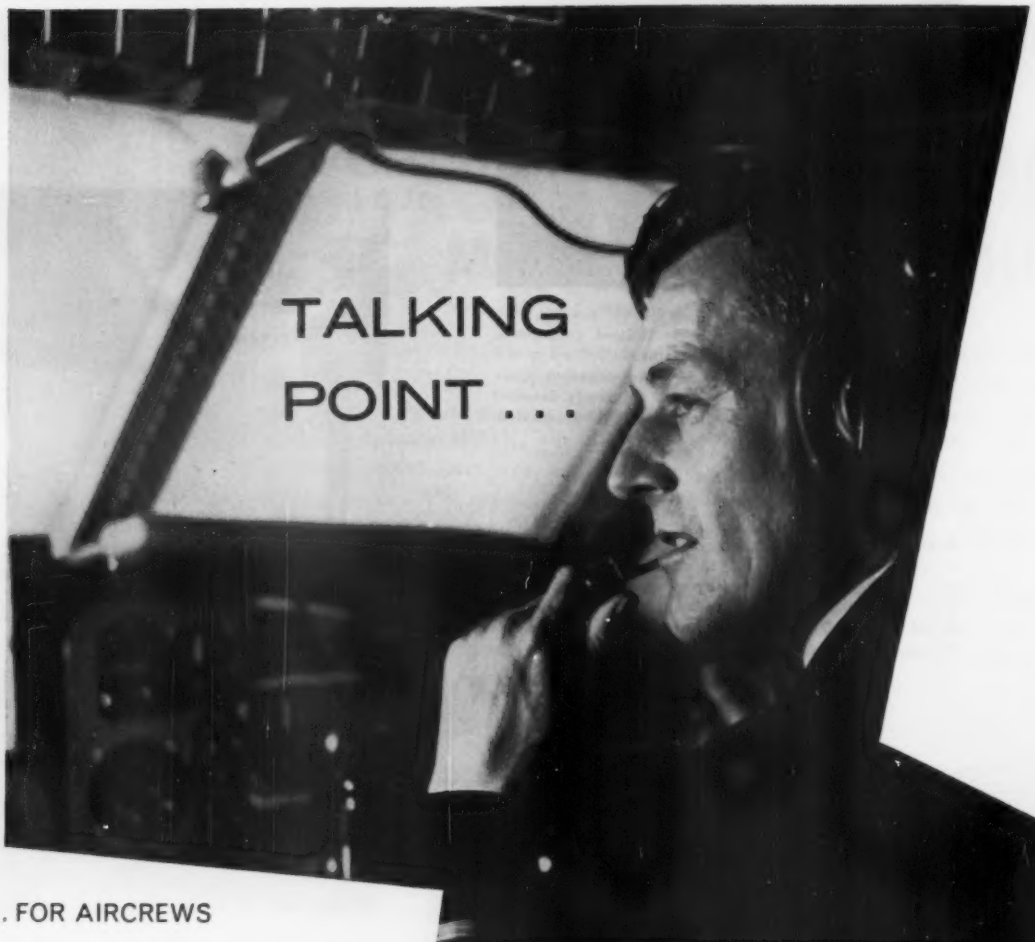

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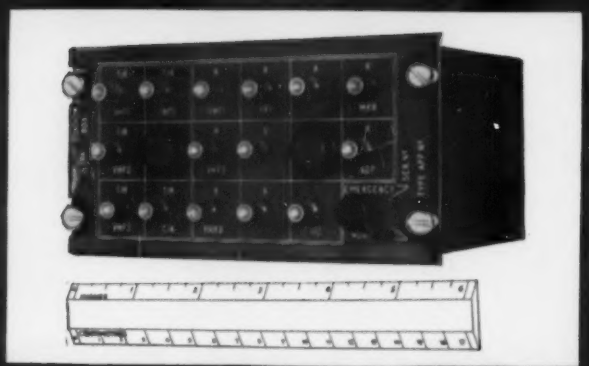

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oped for fabricating ceramic liners for ramjet engines, says Sklarew, it is exact and versatile enough to be used in making ceramics into almost any shape, including that of the new ablating re-entry vehicles.

Looking like a long bullet with a short skirt attached to its aft end, the new Mark IV re-entry vehicle consists of and is fabricated in three separate sections: nose, cylinder and flare. The nose starts out as a closed die forging of the metal backup structure, which is purchased by Lycoming.

In the plant at Stratford, the nose backup structure is turned, milled, drilled, bored and tapped. Ingredients for the Avcoite nose cone heat shield are brought together in another part of the plant and placed in a die wherein the cone shield is formed.

After the Avcoite shield is countour machined, it is placed over the metal backup structure and fastened into place. Cone structures are conditioned in a controlled temperature-humidity chamber before, during and after bonding. The cone is further machined and then sent to the plant assembly area.

Cylinder Construction

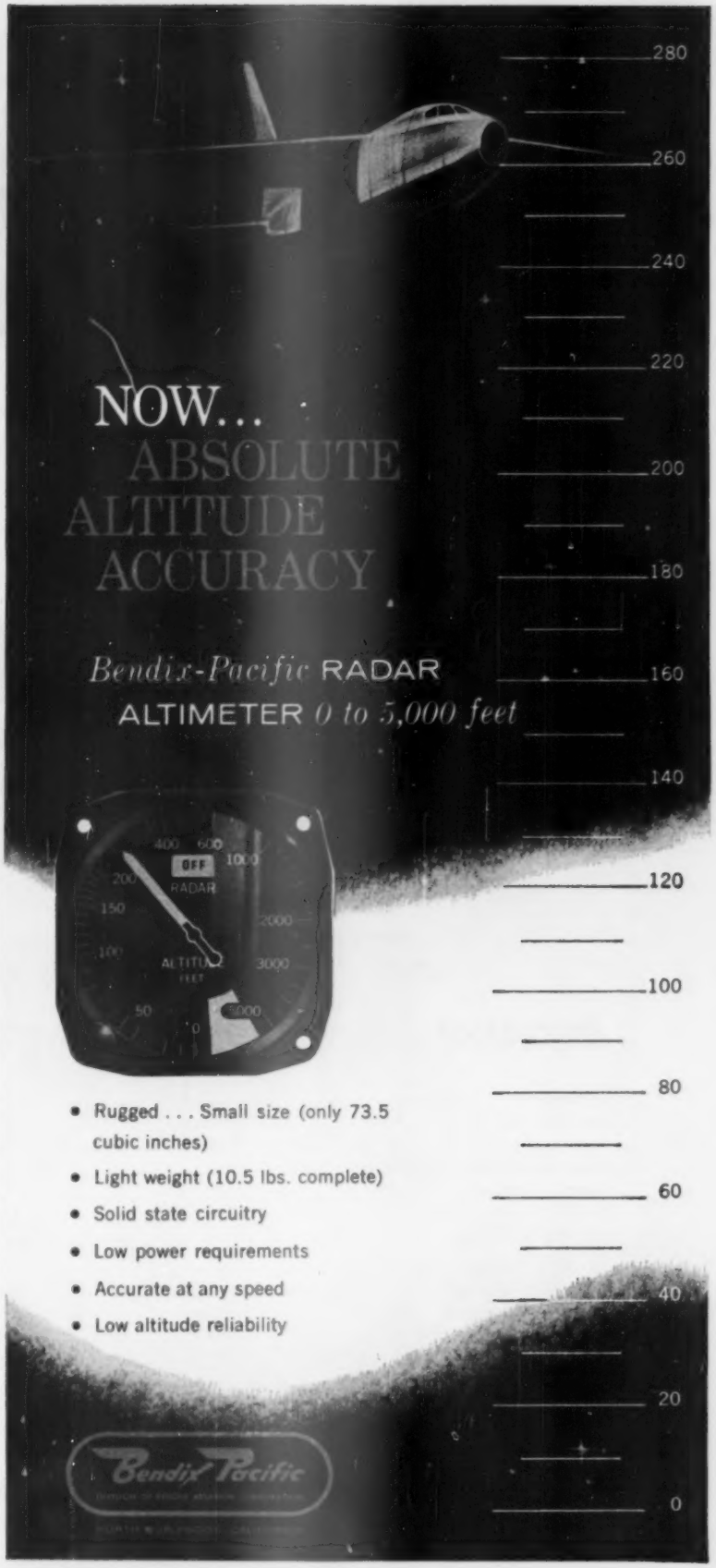
Essentially the same procedure is followed in making the cylindrical section. The cylinder, however, starts out as two roll forgings to simplify fabrication. These are later bolted together to form the metal backup structure. Materials used in the substructure and heat shield are different from those used in the cone section.

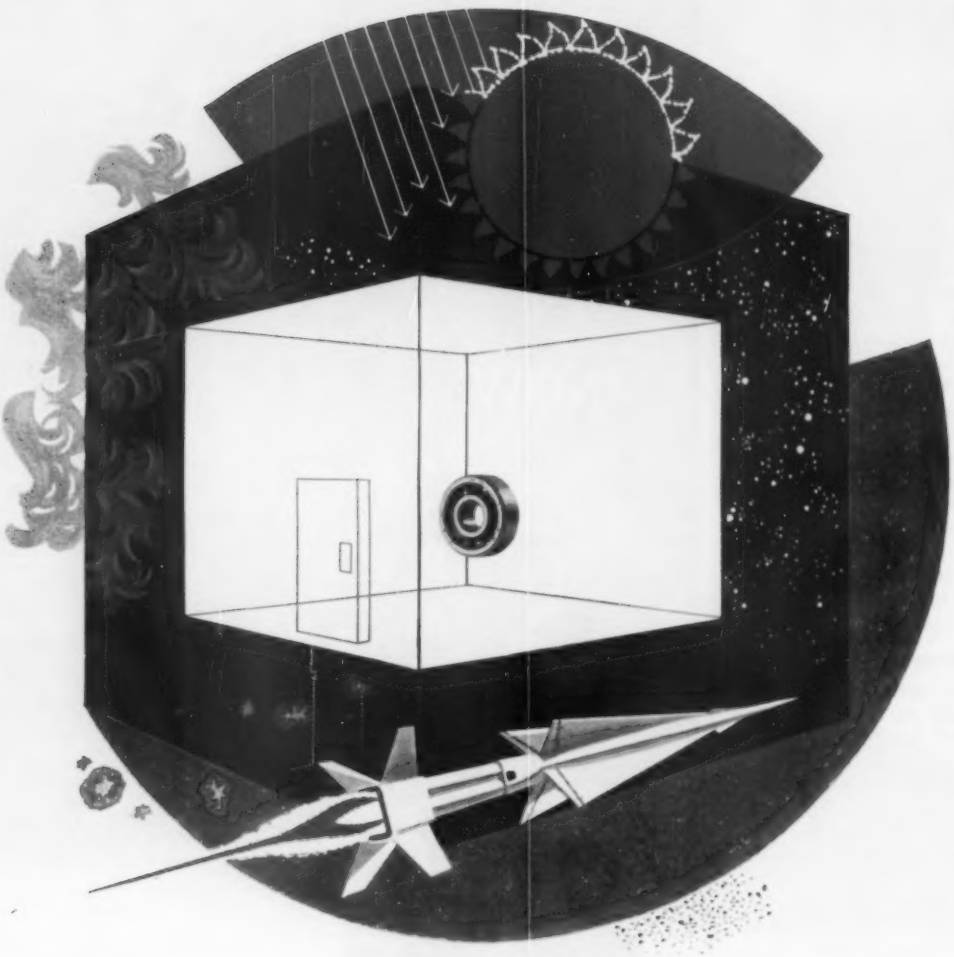
Backup structure for the flare section is the same metal as that used in the nose but is purchased in sheet form. Avco rolls the sheet to shape, rivets the ends together, and adds metal stiffeners.

From here, the flare unit follows essentially the steps of the other two sections to the assembly area where the three sections are mated after they have gone through a series of inspections and have the necessary components added.

From Lycoming's Stratford plant, the finished Mark IV re-entry vehicles are towed to the Bridgeport airport or trucked to Westover Field and then airlifted to their destinations, where additional components or, in the case of the operational vehicles, the nuclear warhead are added. Finally, the re-entry vehicles—at least those destined for flight use—are mated to their Atlas or Titan carriers.

The re-entry vehicle is attached to the top stage of the carrier rocket by means of mechanical fingers. This locking and separating mechanism is located on the small end of a cone which is inserted large end first into the flare section of the re-entry vehicle and attached to the flare's metal backup structure.





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Minuteman Engine Transporter in Road Tests

Minuteman engine transporter prototype, designed and built by Boeing Airplane Co., is shown after completing road tests to measure the effect of movement on all three engine stages of the ICBM. Transporter will be used at Minuteman assembly plant at Hill AFB, Utah.

New Recovery Site Set For Target Missile

Additional range is being provided for the Chance Vought KD2U-1 target version of the Regulus 2 missile with the establishment of a new landing recovery site at Brooksville, near Tampa, Fla.

The new site will implement the normal recovery site at Eglin AFB, Fla.

With a recovery field farther south, the KD2Us can be launched from Venice, Fla., and make their target runs after turning northward. The KD2U has played an important role in Boeing Bomarc interceptor missile development.

The Range Systems Division of Chance Vought has contracted for the site for one year with the New Haven Clock & Watch Co., Conn., which is building an industrial area near the field. Preparation of the former Air Force base for use by Range Systems was handled by Taylor International Corp., Miami, Fla.

Epoxides Have High Temperature Capacity

New York—Union Carbide Chemicals Co. is now marketing a series of new UNOX epoxides which are expected to find ready acceptance in the aircraft and missile industry as a result of their high temperature capability.

Minneapolis-Honeywell and the Brunswick Corp. are two companies that already have developed epoxy resin formulations based on the new UNOX materials. Designated MS 7272, the Minneapolis-Honeywell compound is used for potting and encapsulating electrical and electronic components.

Brunswick's new epoxy formulation, VC-8359, is designed for use in structural applications such as filament-wound rocket motor cases and laminated plastic radomes. The new resin, says Brunswick, maintains a high percentage of its flexural strength at temperatures of 500F and more compared with the conventional epoxy resins, whose flexural strength falls off rapidly above 300F. Compressive strength of laminates made with the new resin at 550F compares favorably with the strength of earlier epoxy laminates at 250F.

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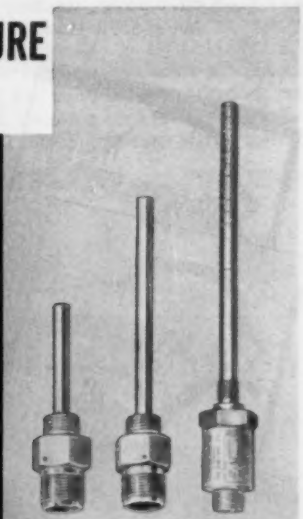

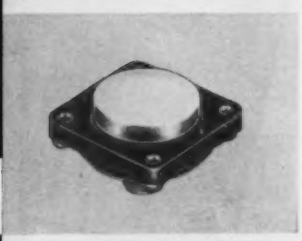

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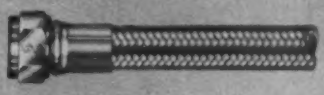

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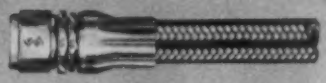

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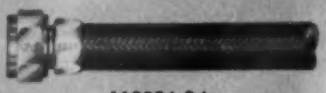

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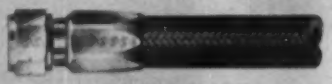

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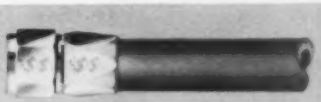

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CONVAIR powered by Allison 501-D13 turboprops with Aeroproducts 606 propellers was modified by PacAero Engineering Corp. Vertical fin height has been increased by 12 in. and the horizontal stabilizer has a 40-in. wider span than the standard Convairliner.

Aviation Week Pilot Report:

Allison Convair Retains Good Air Traits

By William S. Reed

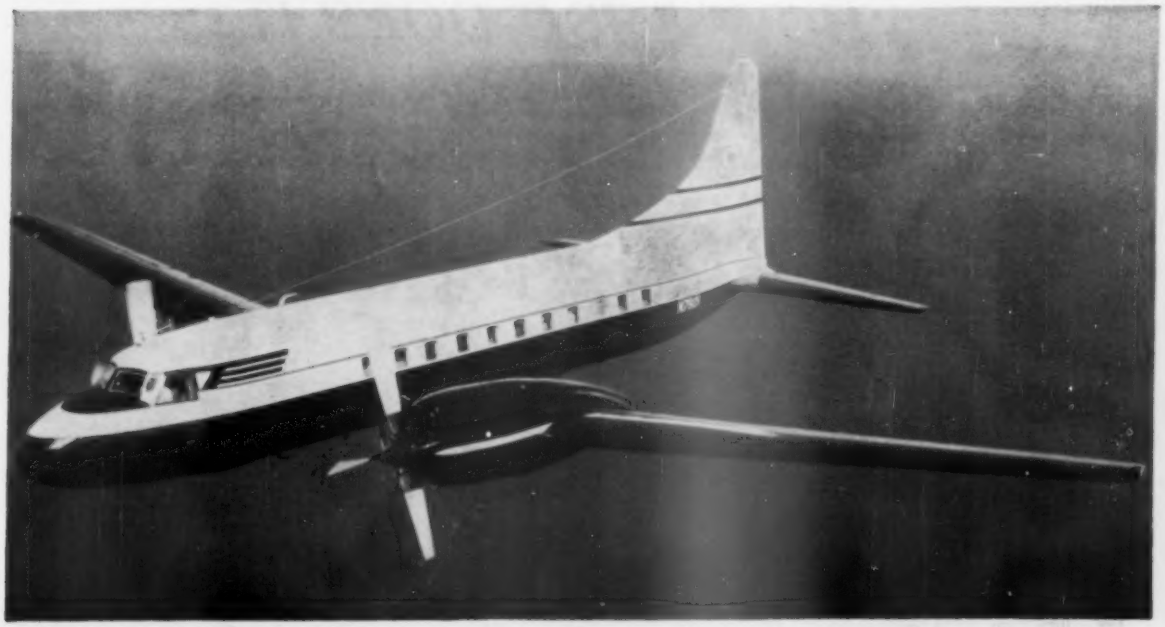
Santa Monica, Calif.—Recently certificated Allison turboprop Convair has retained all the favorable flying characteristics of the original Convairliner and in many cases has improved upon those of the piston-powered aircraft, an AVIATION WEEK flight evaluation showed.

Handling qualities of the turboprop Convair are basically the same as those which earned the "pilots' airplane" label for the Convairliner series. The extensive modifications to the aircraft necessary to convert it to the higher horsepower engines have increased performance without decay in stability or control.

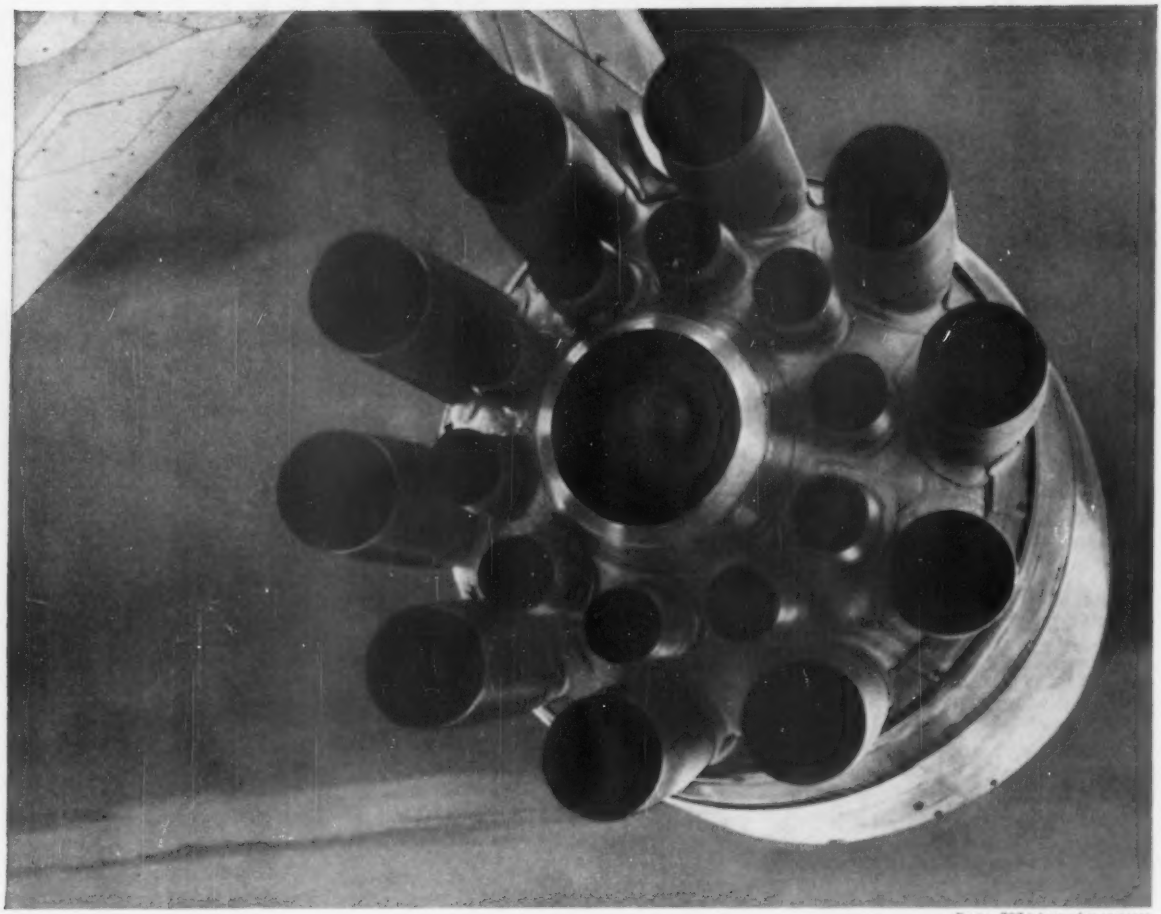
The original Convairliner series features reasonable control forces coupled with ample stability and none of the unexpected foibles which earn the disrespect of pilots. PacAero Engineering Corp. has turned out an aircraft which has honest flying traits and also possesses unusually good single-engine performance.

The particular aircraft for this flight was N5121, eighth in a series of modified aircraft for which Allison Division of General Motors Corp. functions as prime contractor, in turn subcontracting to PacAero for airframe rework, engine and equipment installation, and interior finishing (AW Feb. 29, p. 71).

Most pleasing feature of the conver-



ALLISON turboprop-powered Convair demonstrated very good single-engine performance during Aviation Week pilot evaluation.



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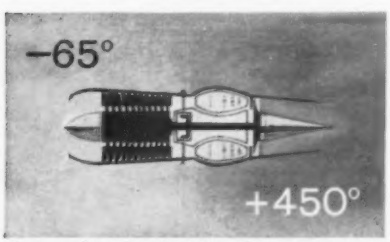
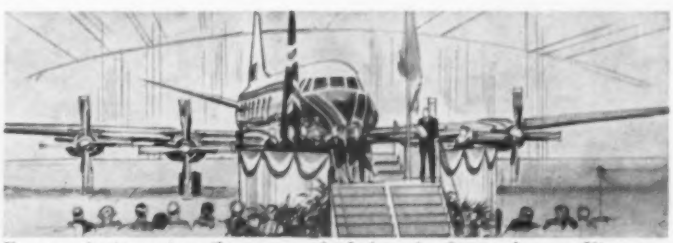
The oil that's safe through 500 degrees F:
HOW ESSO DOES IT!

Jet age aircraft make unprecedented demands on lubricants. Not even the most highly refined mineral oils are able to cope with the temperature extremes in turbine engines. Needed was a *synthetic* oil with good lubricity and stability at very *high* temperatures—and easy-flowing properties at very *low* temperatures. Esso was the first successfully to develop such an oil.



At an altitude of 40,000 ft., temperatures near the intake can be as low as −65° F. Yet in some of the highly-loaded bearings, with rpm up to 14,000, they may soar to 450° F.



Esso synthetic engine oils were ready *before* the first turboprop Viscounts entered commercial service. Esso Aviation Turbo Oils 35 and 15 were the first approved oils for *all* turbine-powered airliners. In fact, the development of these engines depended upon the availability of Esso Aviation Turbo Oils!

INTERNATIONAL AVIATION PETROLEUM SERVICE

ESSO

sion is the increase in performance resulting from the installation of Allison 501-D13 engines turning Aeroproducts 606 propellers, particularly as takeoff and single engine performance is affected. Most pilots generally agree that an aircraft cannot have too much power, especially when increased power usually means that someone in the accounting department will put in a few more seats in an effort to make a profit. In this case, however, even though the maximum allowable gross weight has been increased from 47,000 to 53,200 lb., sufficient power still remains to safely conduct single engine go-arounds from minimum altitude with the aircraft in landing configuration.

Aircraft Modifications

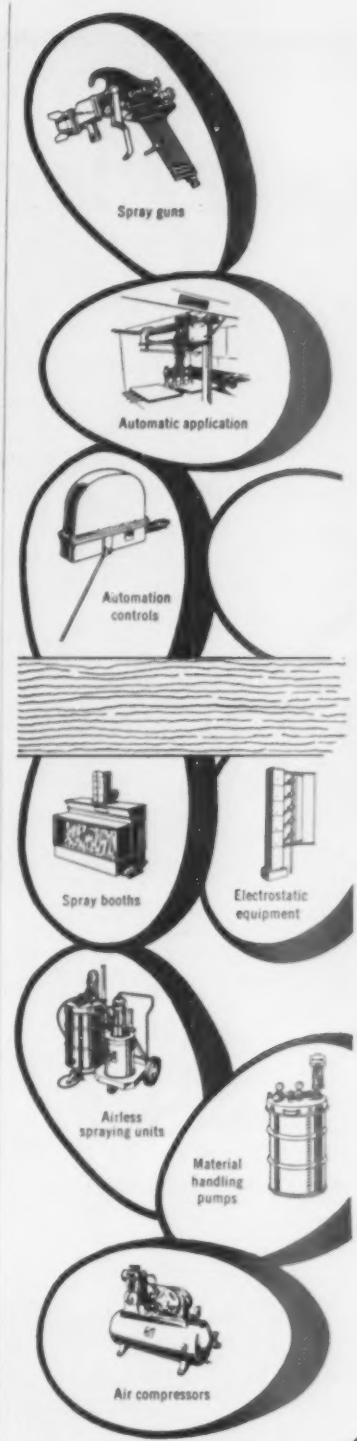
Installation of the turboprop engines results in 50% increase in available horsepower, while the basic empty weight of the aircraft remains virtually the same. Aside from the large area propellers and slightly different engine nacelle contour, other changes are not immediately apparent. Without viewing the Allison Convair alongside one of the conventional Convairliners, it is not immediately noticeable to the observer that the vertical fin is increased in height by 12 in. and the horizontal stabilizer has a 40-in. greater span. Extra fin and rudder area provides the necessary directional control during single engine operation with the increased power available. A third hinge was added to the fin-rudder hinge point to counteract flutter. Added horizontal stabilizer and elevator area provides more longitudinal control to overcome the destabilizing effects of increased power.

Distinctive Noise

A distinctive sensation is provided by the constant noise level of the engines. This is not to say that the aircraft's noise level is higher than that of a standard Convair; the reverse is true. But the engines, from takeoff through climb, cruise, descent and landing, run at a constant 13,800 rpm., all power changes being absorbed by the electronically-controlled, hydraulically-actuated propellers.

The only change in noise level is created by the increasing and decreasing aerodynamic noise, and this is not readily apparent. During descent, and especially in the landing pattern, the variation in engine noise experienced in both jet and reciprocating engine craft does not occur.

Starting procedure is greatly simplified over that in a conventional Convair. A ground turbine compressor, started by the aircraft's internal power, is actuated by a guarded switch which is put into the run position, after which a starter switch is momentarily de-



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CRYOGENIC CAPABILITIES

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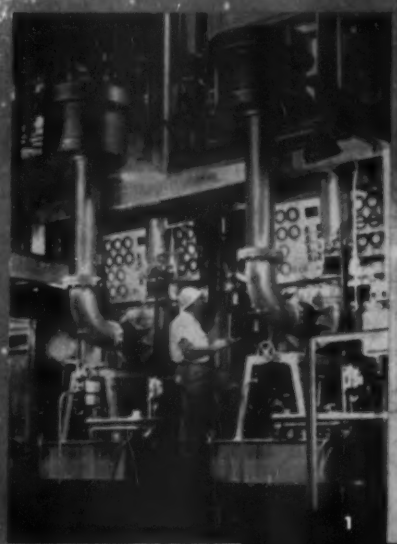

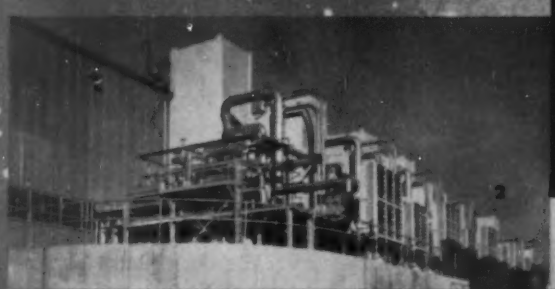

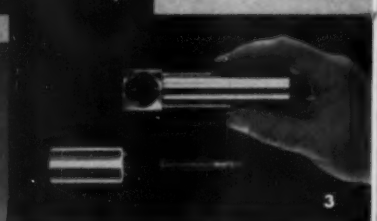

N_2

Great spiral nebula in Andromeda

.....FOR THE SPACE AGE

H_2

1. Tonnage liquid hydrogen facility (U.S.A.F.)
2. Tonnage liquid oxygen facility (U.S.A.F.)
3. Typical miniature heat exchanger and dewars for infrared detectors
4. Mobile helium liquefier (U.S.N.)
5. 7000-gallon tank trailers for long-distance hauling of liquid hydrogen

The conquest of space is demanding vital assistance from that young giant of applied sciences, cryogenics. To this end, Air Products has put cryogenics to work in producing the large quantities of liquid oxygen and liquid hydrogen required for U. S. rocket programs.

But *producing* space-age liquids and gases is only the beginning. The space age requires specialized "hardware" to use them effectively . . . specialized systems to handle them, store them, pipe them and transport them . . . specialized research skills to develop and design equipment and plants of even greater capability . . . specialized fabricating techniques to translate these designs into reality . . . specialized construction engineering abilities to erect new plants with assurance . . . and specialized operating know-how to keep them efficiently on-stream.

Air Products meets these challenges with an unparalleled range and depth of capability that accounts for much of the nation's military cryogenic capacity. As the pioneer and leader in applied cryogenics, Air Products today is as closely linked with U. S. missile and space programs as is cryogenics itself. We are ready to provide data and recommendations on applications of interest to you. Air Products, Incorporated, Allentown, Pa.

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DEFENSE and SPACE DIVISION

'Inside Man' in the search for subs

Jack Welch earned the submariner's Gold Dolphin insignia while serving aboard Navy subs as a Chance Vought missile engineer. Now, M.I.T.-trained Welch is *an anti-submariner*. His incisive knowledge of sub operation is characteristic of the Anti-Submarine Warfare Department of Vought's Aeronautics Division. Today — with missile subs threatening us — Welch and his veteran colleagues are working hand in hand with Vought's Electronics Division and Vought's Research Center on improved underwater detection systems that can find and destroy the hidden enemy.

In addition to ASW systems, Vought Aeronautics develops missiles, aircraft and other products for defense.

CHANCE VOUGHT AERONAUTICS DIVISION DALLAS, TEXAS

pressed. A green light goes on when the compressor reaches operating rpm.

Engine start is accomplished by putting the bleed air selector switch in the gtc. position, moving the fuel and ignition switch to the *On* position and depressing the starter button. The engine primer is depressed momentarily to provide an enriched mixture for ignition.

Once one engine is brought up to speed, the other can be started from the ground compresser or from bleed air supplied by the powerplant, which already is running.

Pre-taxi checks are made on pressure supplied by the one engine-driven hydraulic pump and the two electrically-driven hydraulic pumps, one a.c. and one d.c. Electrical system checks are made on the one engine-driven generator, the two 40 kva. alternators and the standby inverter.

Recent improvements in engine cooling now make the ground idle position (10,000 rpm.) usable, resulting in considerable noise reduction during this phase of operation. A button at the top of the center pedestal-mounted enunciator panel is actuated to put an engine into ground idle. The button returns to position automatically when the power control lever is advanced.

Nose wheel steering, controlled by a wheel at the pilot's left, is used for control during taxiing and until approximately 60-70 kt. is reached on takeoff, just as in the standard Convair.

Lengthy run-up procedures associated with piston engines are not needed to check out the engines. Satisfactory checks on auxiliary power are made before or during taxi, leaving only a check of the feathering system and the full power run-up to be accomplished. The power check revealed that the turbine inlet temperature hit 970C and the engines were producing 3,350 hp., less than the 3,460 hp. which would have been produced on a cooler, standard day.

Takeoff Performance

Takeoff is accomplished in the same manner as the conventional aircraft with the exception that the Allison Convair accelerates faster, making the sequence of events occur more rapidly. The aircraft is rotated smartly and a rather steep climb-out is necessary to prevent the airspeed from building up too rapidly before the gear fully retracts.

PacAero beefed up the main gear fairing doors, raising the gear retraction limit speed from 120 to 150 kt. Even so, 150 kt. will be exceeded if a moderately steep climb-out technique is not used.

A thrust-sensitive signal system is set to automatically feather the propeller if power output to the prop falls below 500 lb. thrust. Auto-feathering is accomplished rapidly enough that drag from the dead engine does not impinge on takeoff performance.

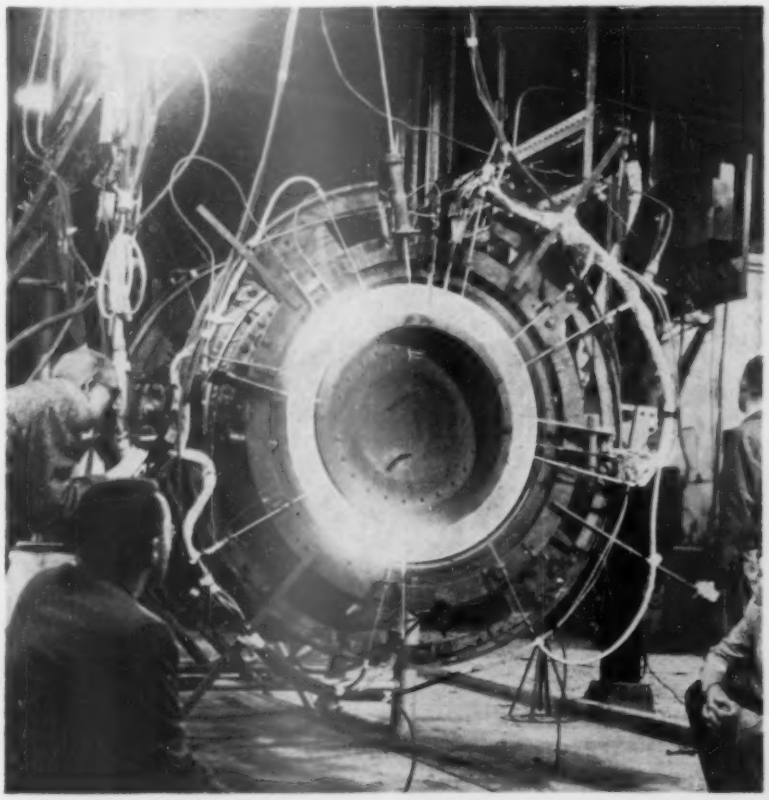
Best rate of climb for the aircraft at maximum gross weight, sea level, standard day, is 133 kt., and this is the speed initially reached. However, the climb angle at this airspeed is so steep that over the nose visibility is seriously compromised. Generally, a more shallow angle results from using about 165 kt.

After climb speed is reached, power is reduced to 895C turbine inlet temperature which produces 3,100 hp. Not included in the horsepower indicated by the torque gages is up to 725 lb. thrust produced by the exhaust.

N5121, which weighed 49,500 lb. at takeoff, was climbing 900 fpm. when approaching 20,000 ft. mean sea level with the turbine inlet temperature at 895C and 1,850 hp. being delivered to the props. If necessary, the entire climb could have been conducted at maximum continuous power with a turbine inlet temperature of 930C, producing 3,450 hp. under standard conditions. Stalling traits of the converted Convair remain unchanged by any of the differences in external configuration due to the conversion. The aircraft commenced a gentle buffet at 85 kt. with gear and 20 deg. of flaps down. At this point, the control yoke was almost fully back and the only way a stall could be induced was to allow the yoke gradually to go forward and then return it rapidly to full aft. Using this technique, a full stall was produced at 78 kt. IAS. Recovery was effected easily with release of the control yoke to the neutral position.

Negative Torque

Check of the negative torque sensing signal was made at 20,000 ft. by shutting off fuel to number one engine. The NTS signal is set to operate if the unit senses between 250 and 370 negative horsepower, such as happens when the engine suffers fuel starvation. When the propeller starts to drive the engine compresssor, the NTS unit



First Photo of GE J93 Burner

Combustion section of the General Electric J93 Mach 3 supersonic cruise turbojet is tested above in rig that allows visual as well as instrumentation checks on its performance. Air is supplied to the combuster with the same temperature, mass flow and velocity experienced over its flight envelope so that all operating conditions except absolute pressure level are correct. Fuel is fed to the combustor until the operational turbine inlet temperatures are reached. Combustion efficiency is measured by taking gas samples. Pressure measurements determine combustor pressure loss. Thermocouples are used to monitor the variation in temperature around the combustor annulus.

Russians Build Modified Mi-1 Helicopter

First photo of a modified Mi-1 helicopter, shown with Aeroflot markings, indicates little external configuration change. The new version has all-metal rotor blades, hydraulic controls and a noise-insulated cabin. Payload is 661 lb., cruising speed 87-93 mph., range at cruising speed 310 mi. and ceiling 19,685 ft. Engine exhaust behind door is changed from earlier Mi-1 and the belly and tail boom housings, possibly for antennas, are additions. Idea for the design was reported as the result of a remark of Premier Khrushchev during a ride to the Kremlin from Vnukovo Airport last November in an Mi-4 that, besides this 8-10 passenger helicopter, a small, compact helicopter—"like the Moskvich automobile"—was needed. Hence the name Moskvich (Citizen of Moscow) for the modified Mi-1, which will be used as an aerial taxi. The helicopter will be equipped for night and all-weather operation as well as for water landings (AW July 4, p. 39).

"coarsens" the prop pitch to unload the drag. A surging then occurs as the prop pitch gently oscillates, warning the pilot by a slight yawing motion that the feathering procedure should be initiated.

Very little drag is produced by the surging. During this flight, the left prop was feathered and 20,000 ft. maintained without advancing power on the other engine above normal cruise. With only one engine operating and the other feathered, airspeed stabilized at 135 kt. Minimum control speed at maximum gross weight is 86 kt.

The aircraft exhibits very good stability characteristics during an approach using the instrument landing system. Sufficient fuel had been used by this time to bring the gross weight down to below 48,000 lb., and the recommended approach speed was 120 kt. Rate of descent of 500 fpm. was established by setting the turbine inlet temperature at 630C, yielding 800 hp. per engine, and with gear and approach flaps of 27½ deg., the Allison Convair eased down the glide path at a steady 120 kt.

Go-around is quite spectacular with the power afforded by the Allison turboprops. Although not attempted on this particular flight, single engine go-arounds at maximum gross landing weight of 50,670 lb. have been accomplished repeatedly during certification without the sweat usually associated with such maneuvers, according to PacAero test pilot Jim Boyd.

Landing the Allison Convair is accomplished with the same ease as its piston-powered predecessor. Final approach of 110-120 kt. is gradually slowed to the ideal over-the-fence speed of 98 kt., from which a slightly nose high touchdown is executed. Here again, the constant rpm. of the engines is disconcerting to a new pilot. Judging by the sound of the engines, the aircraft should have gained altitude rather than settling on the runway when the flare-out started.

Reverse Thrust

Full reverse thrust, approximately 75% power, can be applied as soon as the nose wheel contacts the concrete, which is generally almost immediately after touchdown. The converted Convair, because of the added elevator surface, is somewhat easier to flare than the standard Convair, but is not an aircraft in which the nose wheel can be held off for very long. As usual, the control yoke is held firmly forward by the copilot during thrust reversal because of aileron buffet.

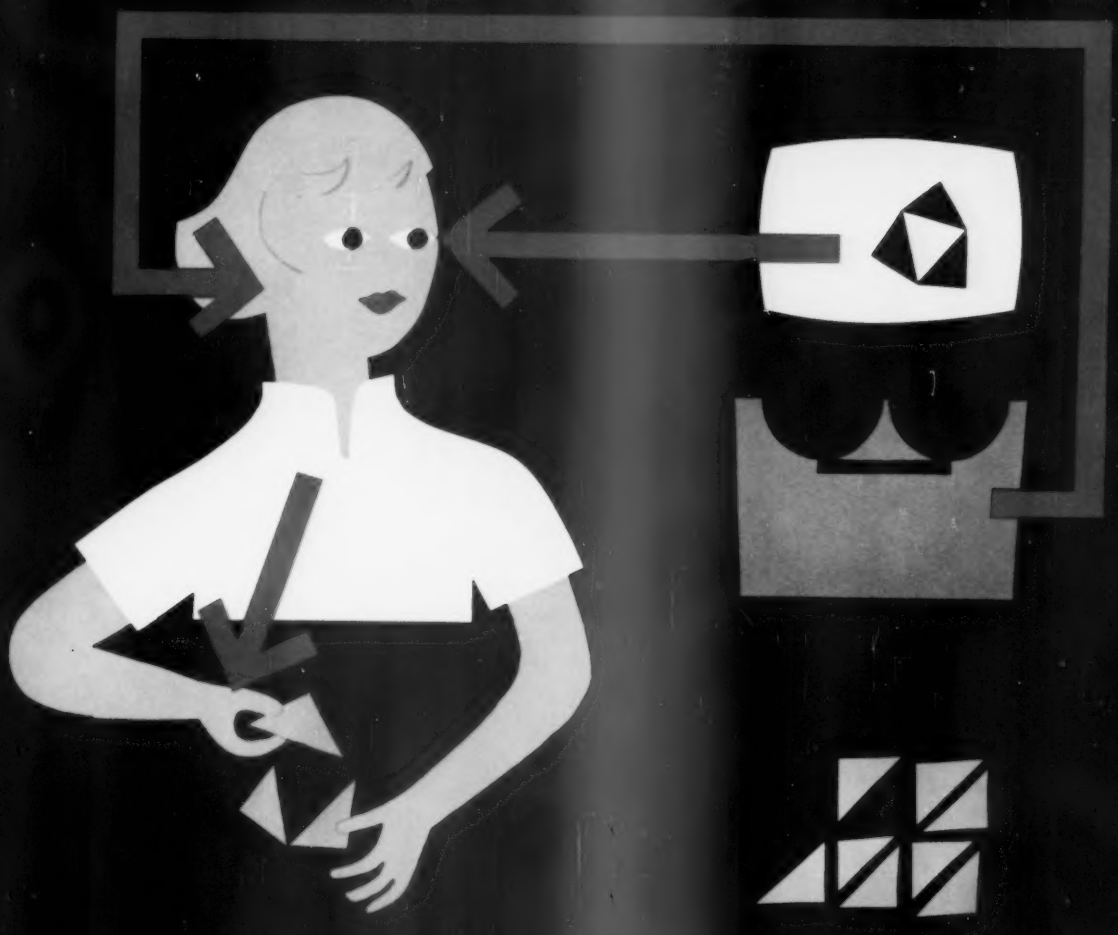
Users of the Allison Convairs now in the field report that they are performing well and have turned up surprisingly few bugs. They report reliable, trouble-free operation and also say that the aircraft have become immediate favorites with passengers and pilots alike. One operator reports that transition requires about 5 hr. for pilots with previous Convair time and about 12 hr. for those without it. The inexperienced operator requires a complete Airline Transport Rating check as part of transition training.

Although the Allison Convairs are now in service, two items remain to be certificated: the autopilot installation and the anti-icing system. Instrumentation now is installed in the number one aircraft to gather data on the bleed air wing and tail anti-ice system, and to establish gain settings for the autopilot.

the proven solution to complex production problems

APPLIED COMMUNICATION SYSTEMS

A Division of Science Research Associates, Inc.



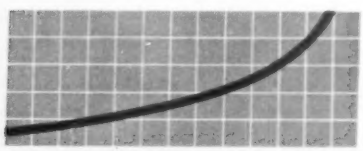
ACS Production Systems A Unique Solution to Production Problems

To solve production problems in the manufacturing of complex products and systems, engineers at Applied Communication Systems (ACS) have created a unique audio-visual manufacturing system. This new production method can be applied to both limited and volume production operations.

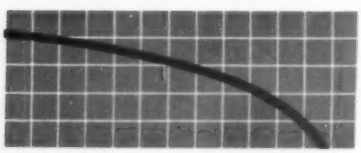
The skill of the trained engineer or production specialist can be captured on synchronized color slides and tape recordings. Translated into step-by-step production assembly instructions, this know-how can be passed on to every production line worker through the use of ACS audio-visual equipment, mounted directly on each assembly work station.

Proven Results

ACS systems have led to dramatic improvements in production, quality and standardization. Production costs have been reduced substantially through increased productivity per work station, and improved production planning. Defect rates and employee training time have been reduced sharply.



PRODUCTIVITY



DEFECTS

Less than a year after a major electronics firm introduced audio-visual techniques, productivity increased approximately *40 per cent above the work standard*. Defects were reduced from *thirteen per unit* to *one-half per unit*. In another industry where complex products are manufactured, productivity per worker increased from two to five units per day after the ACS audio-visual manufacturing system was installed.

Employee morale and motivation usually show considerable improvement because the ACS system increases the responsibility and interest of each production worker's job.

The costly effects of employee turnover and absenteeism on productivity and product quality can be minimized, since employees can be quickly taught through the use of the audio-visual programs.

ACS Production System

These major benefits result primarily from improvements in communications between engineering and production personnel. This improvement is brought about through the use of ACS audio-visual programs and equipment. Resembling a portable TV set, the ACS device contains both a 35 mm slide projector and a synchronized sound tape playback mechanism.

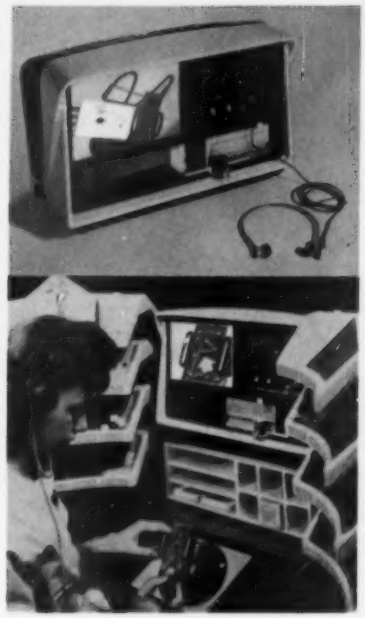
Designed to be mounted directly on each work station, the ACS device stays on the production line at all times. Simultaneously the production worker sees, on his own screen, each step of the assembly process, hears through a lightweight headset the synchronized assembly instructions, and carries out the assembly operation.

To reduce fatigue, carefully selected industrial background music is programmed into each ACS unit. This music is automatically suppressed when instructions are heard.

The ACS audio-visual system allows complex technical information to be reduced to its simplest form and translated into step-by-step assembly instructions which are easily understood even by untrained production workers. The system eliminates the need for blueprints, assembly drawings, schematics, and other written instructions on the production line which require interpretation by the assembly worker. The simplicity of the audio-visual instructions enables the assembly worker to spend much less time interpreting instructions and much more time in actual product assembly. The results are major reductions in learning time for each operation and corresponding increases in proficiency and productivity.

The ACS system provides maximum flexibility. Engineering changes can be made on the production line quickly and easily. Tapes and slides can be stored indefinitely when a production run is interrupted, and the system can be expanded to accommodate changes and improvements in material control methods.

The time standard for each step of the assembly process is built into the sound tape, thus allowing adequate time for the production worker to complete the work element. As each worker's pro-



ficiency increases, the amount of instruction on the sound tape can be reduced.

The Total Work Environment

The success of ACS audio-visual techniques is due largely to the skilled planning of the sequential assembly instructions which are programmed into the ACS device. To be most effective these programs should combine technical information from industrial, and production engineering, quality control, and methods engineering.

The ACS system is a precision engineered combination of equipment, audio-visual programming, and methods planning which is designed to achieve maximum efficiency in manufacturing operations. Although it can be used separately, maximum results are obtained when the ACS audio-visual system is integrated with the ACS engineered work station. When combined these two elements provide a "total work environment" designed to make the operator as efficient as it is possible for him to be.

ACS Work Station

The ACS work station has been designed on the basis of careful micro-motion studies to organize the operator's work space in the most efficient manner. All work station fixtures such as part bins, tools, tool holders, and other equipment are carefully located after a detailed analysis of the production operation has been made. Parts bins are designed to have a considerably greater capacity than that of work stations currently in use. All parts are assigned the simplest nomenclature and arranged in bins in the most logical order for assembly. In this way the ACS audio-visual system is integrated with the arrangement of the work station to insure maximum productivity.

Installing the ACS Production System

ACS production systems can be installed quickly and efficiently in your plant through the complete installation and training service provided by trained ACS engineers.

Because of its flexibility, the ACS production system can be installed during any phase of production.

An ACS engineer will survey your manufacturing facilities and select the production, inspection or testing stations where maximum benefits can be achieved most readily with ACS engineers. At the completion of the survey you may then proceed in either of two ways.

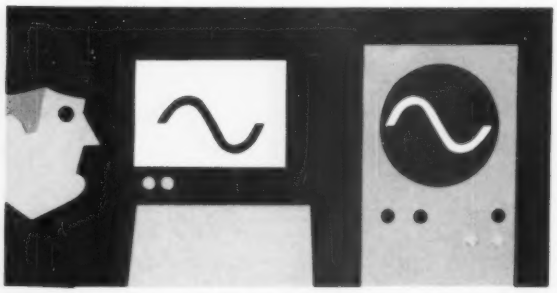
Usually the manufacturer selects two or three of his own technical personnel, typically from industrial and production engineering, to take an intensive course of a few weeks duration in audio-visual production methods at the ACS Communications Development Center in Culver City, California, or Chicago, Illinois.

The newly trained company team works closely with the ACS engineering staff to organize the photographic and sound procedures which are required to install the ACS system on the production line. The ACS staff withdraws after the company team is fully trained, but professional assistance continues to be available whenever needed.

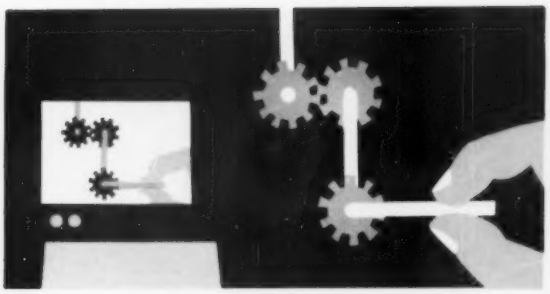
An alternative procedure involves having an ACS engineering team in residence at the manufacturer's site for approximately six weeks to install the ACS system and train personnel in the company.

In both cases ACS engineers work closely with the company personnel to select installation sites and determine optimum assembly methods, inspection and test procedures. Then the entire assembly sequence is photographed including the special tools and equipment and the specialized techniques of the engineer and experienced assembler. Step-by-step aural instructions are taped and synchronized with the slides. In this way the production know-how of the most skilled personnel is permanently recorded and made available for all work stations.

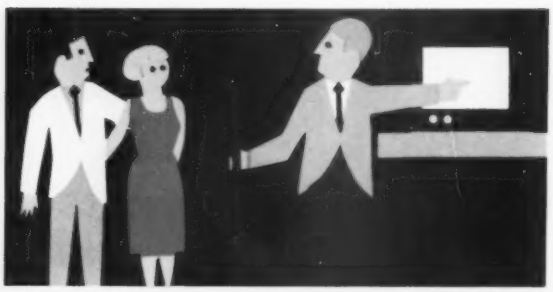
Applications of ACS Systems



Testing, Inspection, Quality Control

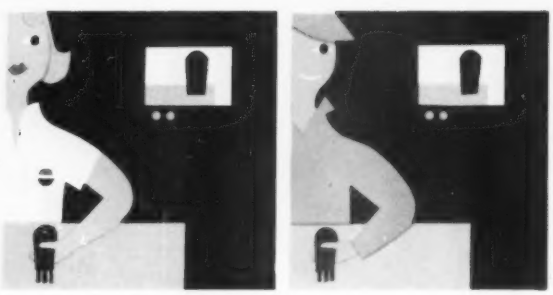


Assembly



Commercial Sales

Personnel Training



Duplication of Exact Procedures

Machine Tool Set-Up

ACS and Your Product

ACS production systems promise to open a new era in competitive manufacturing. Our industry survey team will be pleased to show you what an ACS audio-visual manufacturing system will do in increasing your profits, lowering your costs and improving your competitive position. Write or call: Department A

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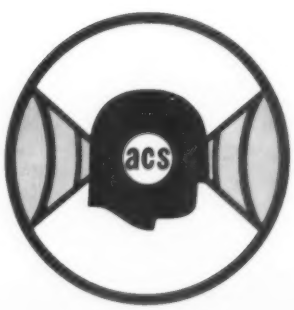
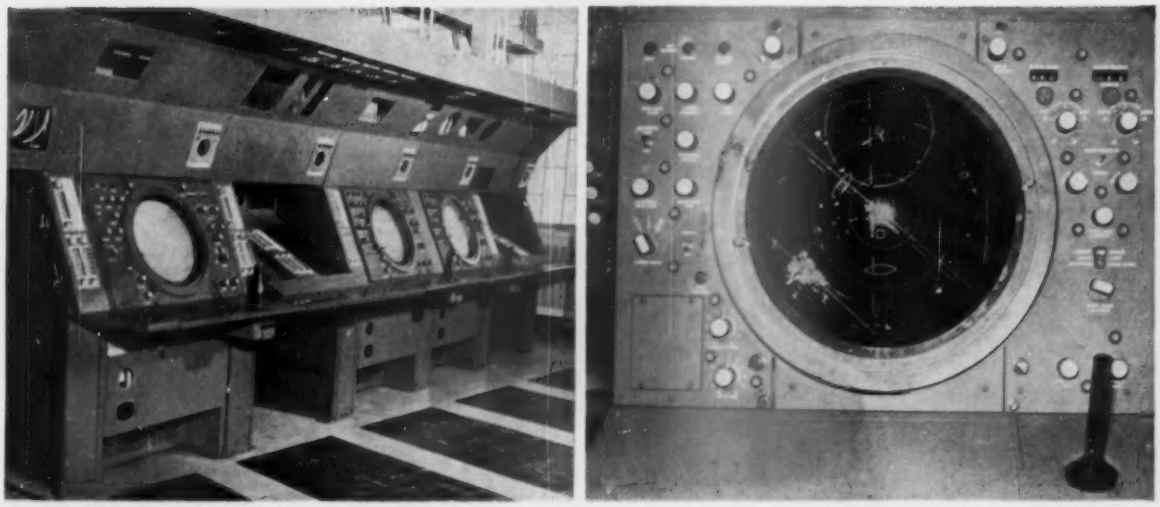




NEW ASR-4 RADAR, now in final test at Newark Airport, is first of improved surveillance radars scheduled for installation at 35 major airports by Federal Aviation Agency. Display consoles, shown in Newark Instrument Flight Rules room, have 16-in.-diameter cathode ray tubes. Closeup shows runways and navigation aids superimposed by electronic mapping technique. Picture shows scope with moving target indication operating to blank out fixed targets to distance of 12 mi. (between second and third range circle), with normal video beyond that point. New ASR-4 radar was designed and produced by Texas Instruments Inc., Apparatus Division.

ASR-4 Airport Radar in Final Test Phase

Newark, N. J.—First of the Federal Aviation Agency's new ASR-4 airport surveillance radars, an improved design slated for installation at 35 major airports, is now undergoing final evaluation tests and should become operational here this summer at Newark Airport.

Designed and built by Texas Instruments' Apparatus Division, the ASR-4 represents the company's first entry into ground-based radar systems and its initial venture into the non-military radar field. In addition to the $10.8 million ASR-4 contract, Texas Instruments will supply FAA with 50 modernization kits for earlier ASR-2 and ASR-3 airport radars under a $2.5 million contract, which will give these radars some of the new features of the ASR-4.

Major Improvements

Here are some of the major improvements which the ASR-4 claims over its predecessors:

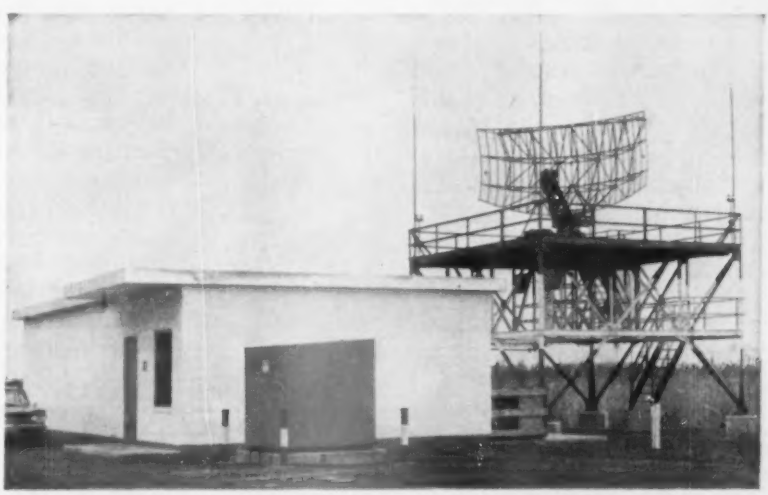
• **Improved coverage:** The ASR-4 is designed to handle aircraft at altitudes up to 27,500 ft. and ranges of 60 mi. Original specifications for the ASR-3 called for coverage to 10,000 ft. and 30 mi., but radar performance subsequently was increased to about 25,000 ft. and 50 mi. range.

• **Improved Moving Target Indicator:** Use of staggered pulse repetition rates essentially eliminates radar's "blind spot" which caused loss of target in previous radars when aircraft had a radial velocity of about 120 kt. relative to radar antenna. ASR-4 blindspot radial velocity occurs at about 1,200 kt., making it possible to see aircraft at speeds up to Mach 2. The MTI provides double cancellation of video fixed targets, instead of single cancellation used in previous ASR radars.

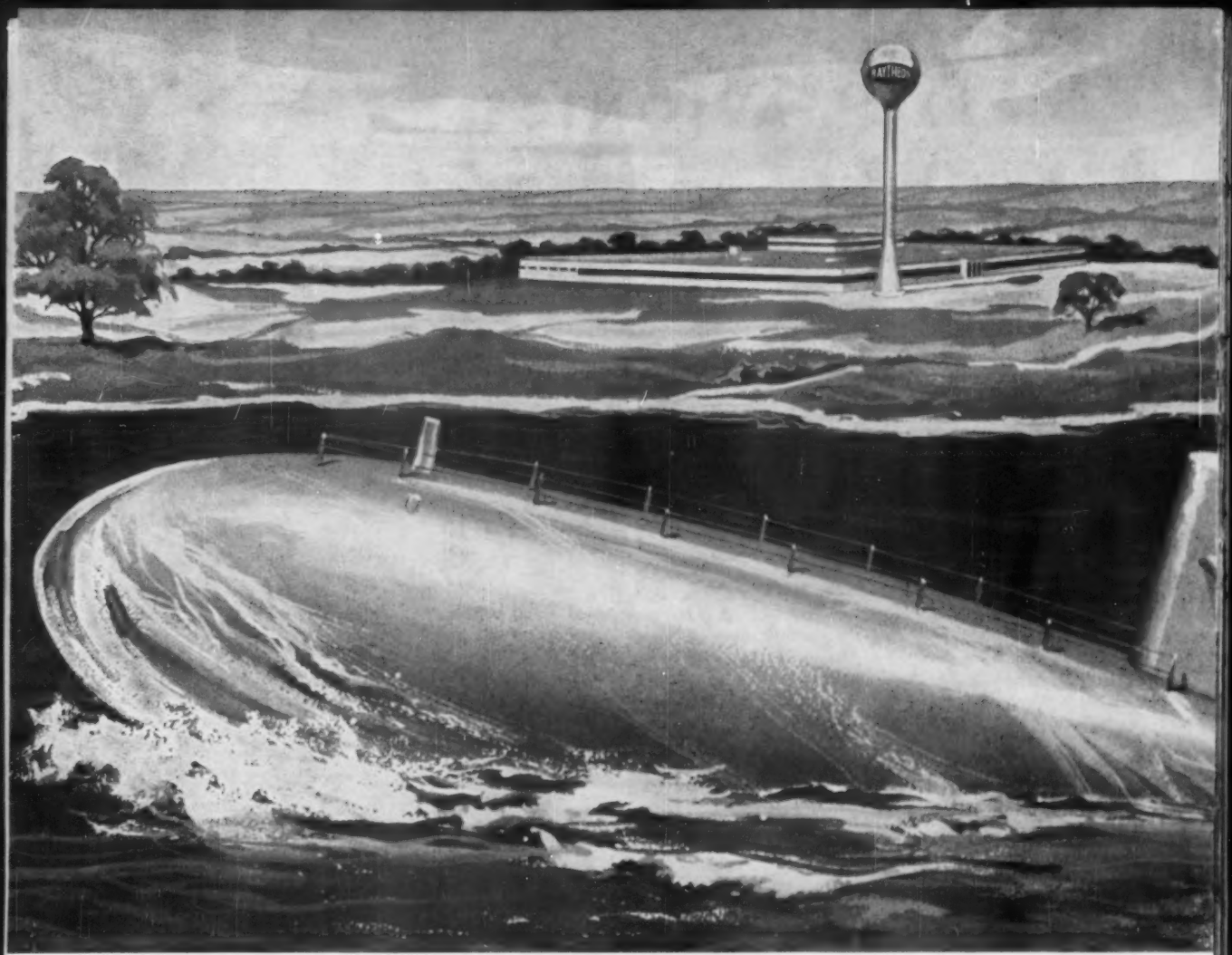
• **Interference Rejection:** The ASR-4 incorporates a number of provisions for minimizing interference from other S-band radars operating in the vicinity.

• **Circular Polarization:** Antenna incorporates provision for circular polarization, as well as more conventional vertical polarization, to reduce clutter during heavy rainfall. ASR-3 originally did not have circular polarization but it has subsequently been modified to incorporate this feature.

• **Signal Enhancer:** The ASR-4 incorporates a video integrator which provides signal enhancement, with up to 120 db. of integration for weak signals at longer ranges. System can be operated with non-integrated MTI video out to any range selected by the controller and with integrated video



ASR-4 radar antenna at Newark adjoins structure which houses transmitters, receivers and performance-monitoring equipments. Radar has 60-mi. range at 27,500 ft. altitude.



Raytheon activates industry's first center for Anti-Submarine Warfare, Portsmouth, R. I.

Now functioning, Raytheon Submarine Signal Operations' new ASW Center designs, develops and produces complete systems for detection-through-destruction of objects in *hydrospace* (ocean depths and interface). Sub-systems embrace: torpedo guidance and location devices; sonar and mine countermeasures; communications, IFF, oceanographic equipments.

Among unique Center facilities are: 180,000 gallon "L"-shaped acoustic tank; Alan, fully-equipped 65 ft. mobile sonar test boat; acoustic pressure tank up to 6000 psi.

Current programs provide for 3D omni or highly directional submarine, air, and ship-borne sonars; trainers; listening and measuring devices. Past advances effected by this Raytheon capability include: first fully hull-integrated comprehensive detection system — for Navy's nuclear-powered hunter-killer submarines; transistorized deep-dip airborne sonar; first helicopter-borne echo ranger; non-interfering sonar trainers. We believe location, facilities, and capability make this the nation's primary industrial center for ASW research, advance development, engineering, and production.

RAYTHEON EQUIPMENT DIVISION

Excellence in Electronics

For Raytheon ASW Capabilities Brochure, *Write: Director of Marketing, Equipment Division, Dept. B1, Raytheon Company, West Newton, Mass.*

beyond the range which is selected. • **Automatic Performance Monitor:** Performance of the ASR-4 is continuously measured in terms of key parameters such as power output, voltage standing wave ratio of waveguide and antenna, transmitter frequency and system noise figure, with automatic warning lights to indicate to the controller whenever a critical parameter falls below prescribed standards.

Radar Displays

The ASR-4 installation at Newark provides four plan position indicators (PPI), three operational and one for maintenance, each consisting of a 16-in. aluminized cathode ray tube with a P-7 phosphor screen, one-third larger than previous scopes. Number of PPIs used at any installation depends upon the operational requirements.

Each PPI console contains necessary receiver controls which enable the operator to select desired range, MTI/normal gate length, and any one of three modes of video presentation—normal radar video only, moving target indication only or a combination of both.

Navigation, landing aids and approach paths are superimposed on the display by electronic means, which eliminates the plastic overlays used in the ASR-2 and ASR-1. The electronic mapping provision automatically changes the scale factor of the navigation/landing aids display when the range of the scope itself is changed. Texas Instruments has used circuits providing 145 lines per inch, which reduces thickness of the mapping lines to about ⅛ in. on the six-mile range scale.

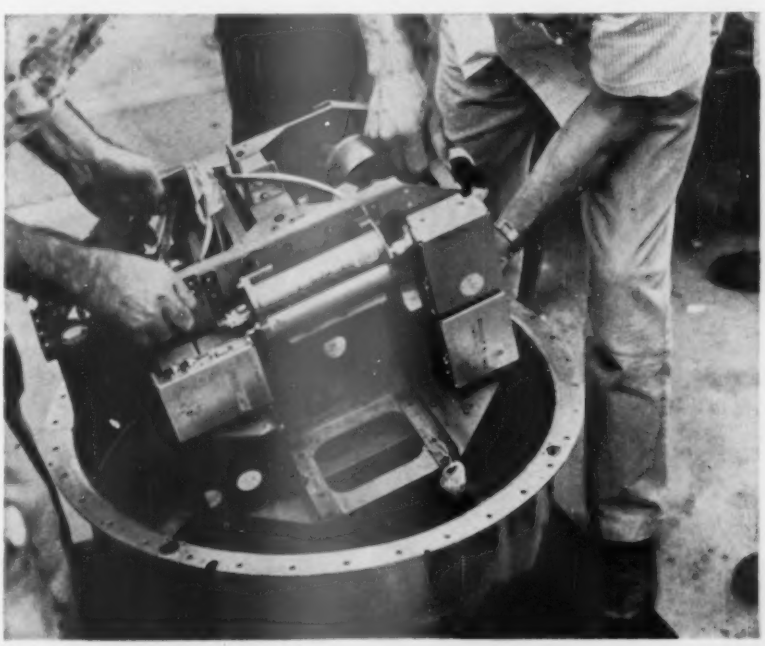
The ASR-4 incorporates an electronic strobe and cursor which enable the controller to quickly determine the distance and bearing to any aircraft on the scope. A small "joystick" on the right corner of the console is used to position a small intensified spot on the target, after which aircraft range is indicated on a counter. Joystick also is used to position electronic cursor to intersect target, which causes its bearing to be indicated on another counter. Cursor origin can be set to determine target bearing relative to radar antenna or to an offset point.

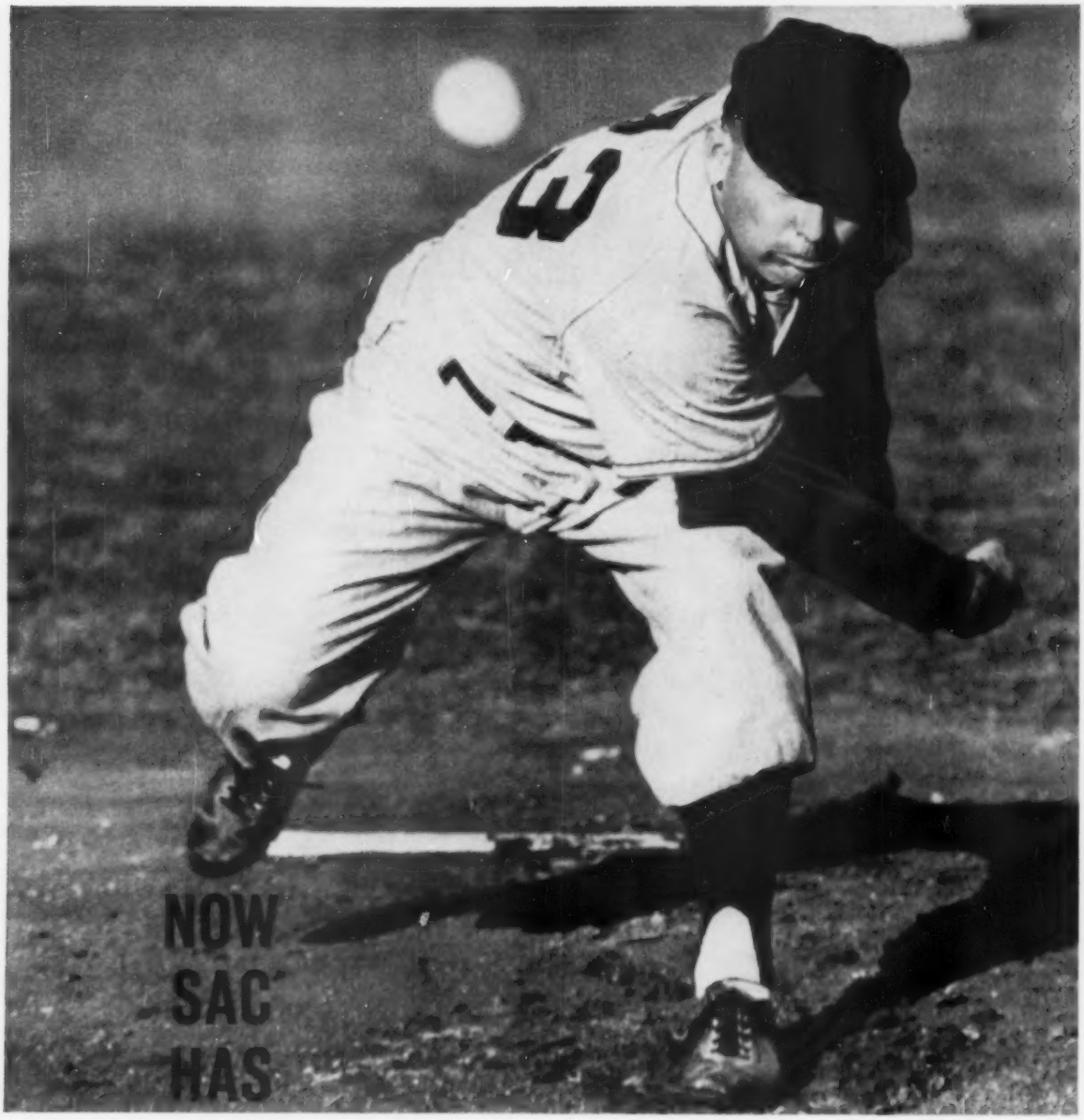
Growing number of civil and military surveillance radars has raised problems of mutual interference with earlier ASR radars, which prompted the present design effort to reduce interference. Provisions included in the ASR-4 include a filter which reduces spurious magnetron signals, and a three-cavity preselector filter, tunable from 2,700 to 2,900 mc., which limits receiver bandwidth to 10 mc. at the 3 db. down point.

The ASR-4, like the ASR-2 and

Discoverer XII Was to Analyze Recovery Sequence

Unsuccessful Discoverer XII vehicle launched last month (AW July 4, p. 39) carried a re-entry vehicle and recovery capsule instrumented to monitor the events leading to recovery, including separation from Agena, retrorocket activation, rocket cone ejection and parachute deployment. Object was to detect reason for failures of attempted recoveries. Top photo shows instrumentation in retrorocket cone. Bottom photo shows monitor instrumentation being inserted in capsule at Lockheed Missiles and Space Division.





TWO STRIKES ON THE OPPOSITION

When SAC's B-52 crew steps up to the mound it can throw two deceptive curve balls before winding up to deliver the third strike. Two GAM-77 HOUND DOG air-to-surface missiles slung beneath the wings of the B-52 intercontinental bomber can quash enemy defense centers and clear a path to the main target.

Blazing into action at supersonic speeds, these GAM-77's can be used either on resistance points or on the main objective itself. Inertially guided, they can fox enemy radar by making passes at pseudo-targets before heading for the actual one. To further confuse the opposition, the jet-powered missiles can fly high or low on the way to the strike zone.

The GAM-77 HOUND DOG was designed and is in production for SAC by the Missile Division of North American Aviation.

THE MISSILE DIVISION OF
NORTH AMERICAN AVIATION, INC.
Downey, California

ASR-3, is built in duplicate except for the antenna to provide complete standby capability in event of failure. Each channel of the ASR-4 has built-in automatic performance-monitoring provisions, as well as circuits for detecting over and under-voltage, under-current, modulator inverse current and modulator-driver over-current. If one of these faults should occur, modulator and driver voltages are removed for five seconds, to allow fault to clear, after which voltage is again applied. If the system re-cycles three times without clearing the fault, it locks out with voltage removed and signals operators at the PPI console and at the transmitter site to switch over to the standby system.

Similar protection is provided in event that cooling air flow to the magnetron is interrupted, magnetron temperature exceeds safe limits, or there is loss of bias supply for the modulator, high-voltage supply or transmitter, except that the system locks out without recycling.

The 17½ ft. wide rotating antenna, built by Gabriel Electronics Division of the Gabriel Co., is designed to operate without radome protection. It provides a 1½ deg. wide beam in azimuth and a cosecant-squared shaped beam in elevation. Antenna rotates at 15 rpm. Selection of vertical or circular polarization can be made by remote control from operator's console. Antenna gain is 34 db. with first sidelobes down at least 20 db., according to Texas Instruments. Reflector also supports a 28 ft. long radar beacon antenna.

The dual transmitters, each rated 0.5 megawatts peak power, dual receivers and automatic performance monitoring equipment are housed in a structure adjoining the antenna at Newark Airport.

Having cracked the highly competitive civil ground radar field, Texas Instruments management hopes to develop considerable future business in the field, both in new equipments and in updating existing systems. Company's Apparatus Division has penetrated the foreign market with the sale of a radar modernization kit to Belgium.

FAA Unveils Fremont En Route ATC Center

FAA has unveiled its multimillion dollar air traffic control center at Fremont, Calif., which will assume en route control over all military and civilian IFR flights in its territory this autumn. The Fremont Center, in assuming control responsibility from the present Oakland facility, will be the first of 13 such highly-instrumented and automated facilities in the nation. Similar centers at Cleveland, Atlanta

MPB announces . . . 3 new R's of instrument bearings

Latest additions to the large, fast-growing MPB family are ultra-precision R2, R3, and R4 instrument bearings.

To their many familiar applications such as computers, servos, synchros, gyros and generators, MPB's R Series bearings bring quieter performance, longer life and reduced friction — the results of MPB's advanced production techniques, thorough quality control and constant emphasis on precise, accurate bearing geometry.

R2

Basic material for the R Series is 440C stainless steel. A new type ribbon retainer, for low uniform torque, is available, as are duplexed mountings and preloaded pairs. ABEC Class 7 tolerances maintained in all types and sizes. Standard dimensions are

R3

	Bore	O.D.	Width
R2	.125"	.375"	.156"
R3	.1875"	.500"	.156"
R4	.250"	.625"	.192"

R4

Find out now how MPB bearings and technology can benefit your products. Call your MPB Sales Engineer or write for information. Miniature Precision Bearings, Inc., 1107 Precision Park, Keene, N. H.

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CONTROL TOWER IN A
U.S. AIR FORCE
F1H-105

SPECIAL DELIVERY PACKAGE

Portable air traffic control towers—to be produced by Hamilton Standard—can be flown or trucked to speed mobilization of remote TAC air fields

The Air Force has selected Hamilton Standard to produce 150 air traffic control vans, plus 53 trailer-mounted electronic shops for servicing the control vans and other types of electronic equipment in the field. The van will be used, as shown here, by the Tactical Air Command to direct air traffic at remote or temporary landing fields.

LIGHTWEIGHT, RUGGED, EASY-TO-OPERATE—Each van weighs about a ton, measures 5′ x 5′, yet houses an operator, transmitters, receivers, and most of the basic weather equipment of large airport control towers. The units are built to withstand the most grueling environmental conditions—sand, wind, dust, ice, humidity, altitude. Every construction element—equipment, lighting, sound conditioning—is engineered to blend man and equipment into an efficient operating unit.

OTHER GROUND SUPPORT EQUIPMENT IN PRODUCTION at Hamilton Standard includes liquid cooling carts for an advanced airborne missile system, cooling packages for a missile silo application, and electrical simulators for military cargo aircraft.

SOLID FOUNDATION FOR YOUR GSE—Hamilton Standard has the ability to supply the widest range of aircraft and missile ground support equipment—from tiny precision components to complete architectural structures and weapon subsystems. This ability stems from over 40 years' experience in systems-engineering its own laboratories and broadening product lines. To learn how this vast engineering resource and Hamilton Standard's world-wide service organization can serve you, phone or write: Hamilton Standard Ground Support Equipment Department.

HAMILTON STANDARD

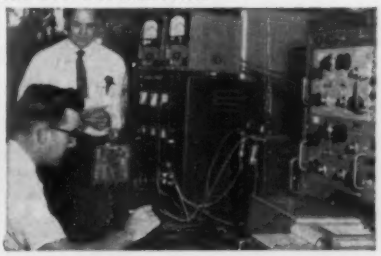
DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

SOME OF THE MANY FIELDS OF GROWTH AT HAMILTON STANDARD

ENVIRONMENTAL CONDITIONING SYSTEMS for space vehicles and such advanced aircraft as the B-58, 880, B-70 are important aspects of Hamilton Standard diversification.

ENGINE CONTROLS for over 20,000 aircraft gas turbines have been produced by Hamilton Standard. The company's latest control work involves advanced rocket engines.



ELECTRONICS at Hamilton Standard includes broad experience in flight control, instrumentation, static power inversion and electrical control for aircraft, missile and GSE components.

AIRESEARCH JETSTAR CUSTOM INTERIORS

America's first pure jet corporate transport, the four-engined Lockheed JetStar, is an extremely high speed, pressurized aircraft. This advanced tool of modern management requires the utmost skill in the construction of furnishings and equipment and their attachment and fitting to the airframe. AiResearch Aviation Service provides this critically important skill through actual experience, having designed and installed more executive interiors for pressurized aircraft than any other company.

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A full-scale mock-up of the cabin is used for prefitting the custom-built furnishings to insure precision work and reduce modification time. This modification includes exterior painting of the aircraft and ducting of the AiResearch pressurization system, standard equipment on all Lockheed JetStars.

The most complete modification center of its kind, AiResearch Aviation Service employs more than 600 highly trained and experienced engineers, technicians and craftsmen using the most modern manufacturing and testing equipment in the industry.

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AiResearch Aviation Service Division

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and Jacksonville are now under construction, and ground has been broken for six more.

Approximately 6,000 mi. of airway is included in the Center's territory, which stretches from Bakersfield, Calif., to the Oregon border and from midway across Nevada to a point in the Pacific halfway to Hawaii.

Greatly increased air traffic in northern California is the reason for Fremont Center's priority. Its 55,000 sq. ft. will contain 53 control positions, four separate radar systems, 19 horizontal and 18 vertical radar displays. A total of 277 traffic control personnel will be required when the Center opens Oct. 9. Of approximately $2 million in advanced electronic equipment to be installed, the following is featured:

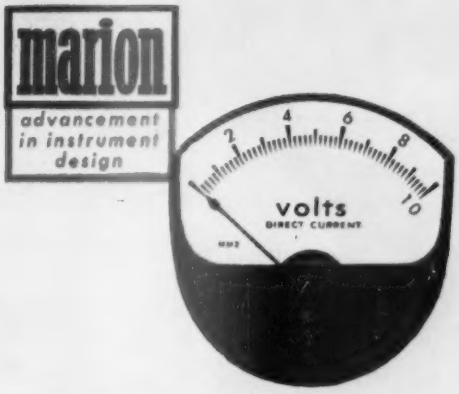
• **Bell-designed switching system,** No. 300, a unit which combines telephone, radio and radar into one console. System will provide speed direct-line communications with adjacent control centers at Seattle, Salt Lake City and Honolulu, and with all civil and military airports in the control area by means of a fast, pushbutton dialing system. Overrider features permit any console operator to contact any other operator in the Center in event of emergency.

• **Remington Rand Univac computer.** Not expected to be ready until Feb. 1961, the computer will print out all flight progress strips at 600 lines/min. (At present two small IBM computers are being used to prepare approximately 35% of the Oakland Center's daily production of 7,000 flight progress strips.) New computer will also contain random-access magnetic memory of up to 1.8 million bits, in which will be stored flight plans, fixes, and supplementary reference data.

• **Fully automated strip delivery** from print-out stage to appropriate control position, via a conveyor belt system.

• **"Transponder" system** developed by telecomputing in which the aircraft in flight, instead of passively reflecting a radar signal, is instead "interrogated" by a coded signal from the ground. Special equipment in the aircraft instantaneously responds with a discrete coded signal, giving several types of information. This includes type of aircraft, destination, speed and altitude. When appropriate, remote radar sites send and receive signals on land-line command from the control center.

Conventional radar will also be used in conjunction with the telecomputing system, with the nucleus of the system located at Scarper Peak in the San Mateo hills. Radar will be remoted to the Center from there and from other sites at Paso Robles, Red Bluff and Sacramento.



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Honeywell

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AT WESCON, BOOTH 2722

PROBLEMATICAL RECREATIONS 23

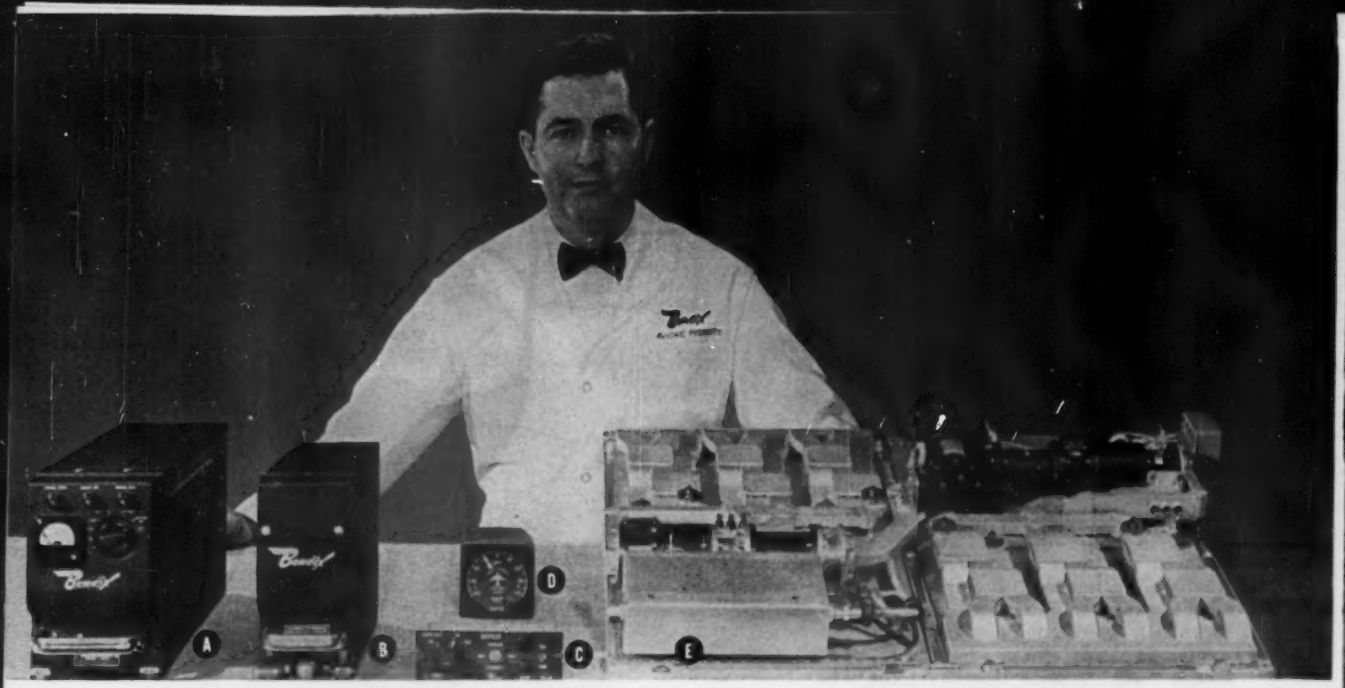
Assume that every tree has at least one leaf. If there are more trees than there are leaves on any one tree, then there exist at least two trees with the same number of leaves. Is the conclusion valid?

—*School Science & Mathematics*

Logic prompted us to acquire Servomechanisms (Canada) Ltd., whose main plant is in the Rexdale area of Toronto. Our operation there will be closely linked with our production of inertial guidance systems for the Lockheed CF-104 fighter-bomber of the Royal Canadian Air Force.

ANSWER TO LAST WEEK'S PROBLEM: There's no closed form solution, but patience will get you 8987.

LITTON INDUSTRIES
Beverly Hills, California



The Bendix DRA-12 Doppler Navigation System, pictured above, weighs only 61 pounds. (A) Tracker Unit—½ ATR package completely transistorized for greater reliability; (B) Transmitter-Receiver—short ⅜ ATR package requiring only single microwave connection (plus cabling) with antenna; (C) Control Unit—designed to RTCA-SC-46 specifications for installation in aircraft panel; (D) Indicator—standard, integrally-lighted instrument showing ground speeds up to 999 knots; (E) Antenna —four-beam planar array measuring only 3½" at thickest point.

BENDIX DOPPLER

Years-ahead design anticipates airline

Built-in airline accuracy and reliability are the chief reasons why Bendix leads in commercial jetliner Doppler navigation. These essential qualities are the direct result of the advanced design and painstaking fabrication of the Bendix Doppler System, and they are the key factors that led United Airlines to select the Bendix system over all others.

Here are 10 reasons why Bendix Doppler is ahead today, and will be in the years to come:

1 The DRA-12 Bendix* Doppler Navigation System weighs only 61 lbs., and its companion CPA-24 Navigation Computer only 14 lbs.

2 Completely transistorized** for maximum reliability.

3 Employs fixed, passive, four-beam planar array antenna only 3½" at thickest point.

4 Utilizes FM/CW Doppler principle to give maximum efficiency at low power consumption.

5 High degree of accuracy in ground speed and drift angle information permanently maintained through use of digital computer techniques.

6 Coherent detection permits operation with signals more than 20 db below noise level.

7 Eliminates altitude holes through use of unique modulation method.

United Air Lines selected the Bendix Doppler Navigation System for its new DC-8 Jet Mainliner fleet operating between California and Hawaii. Bendix Doppler will greatly increase operational efficiency over this long over-water route by reducing in-flight time and lowering fuel consumption.

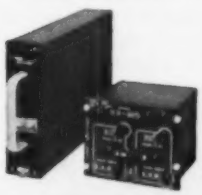
NAVIGATION SYSTEM

performance needs . . . today and tomorrow

8 Maximum accessibility for maintenance achieved through use of plug-in computer circuit boards and sub-chassis construction.

9 Modulation system, computer elements, and other critical circuitry engineered for expansion into Mach 2 and Mach 3 aircraft.

10 Backed by full line of test equipment and complete maintenance training program.



Here is the Bendix Navigation Computer System, companion to the Doppler System on opposite page. This highly accurate system, weighing only 14 lbs., accepts ground speed and track information from Doppler System to continuously compute ground position relative to a selected track. This information is displayed as a direct readout in front of the pilot as distance to his destination and his position to the left or right of the selected track.

*REG. U.S. PAT. OFF. **EXCEPT FOR TRANSMITTING KLYSTRON AND ITS VOLTAGE REFERENCE

Bendix Radio Division

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Dilecto laminates are only one family of products from industry's largest selection of non-metallic structural materials and electrical insulations. Vulcanized fibre, silicone rubber and mica, and thermosetting moldings are also supplied by CDF.

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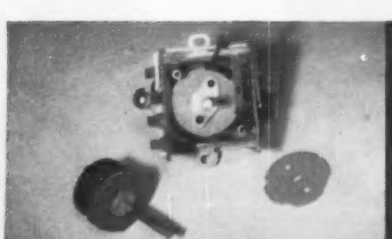
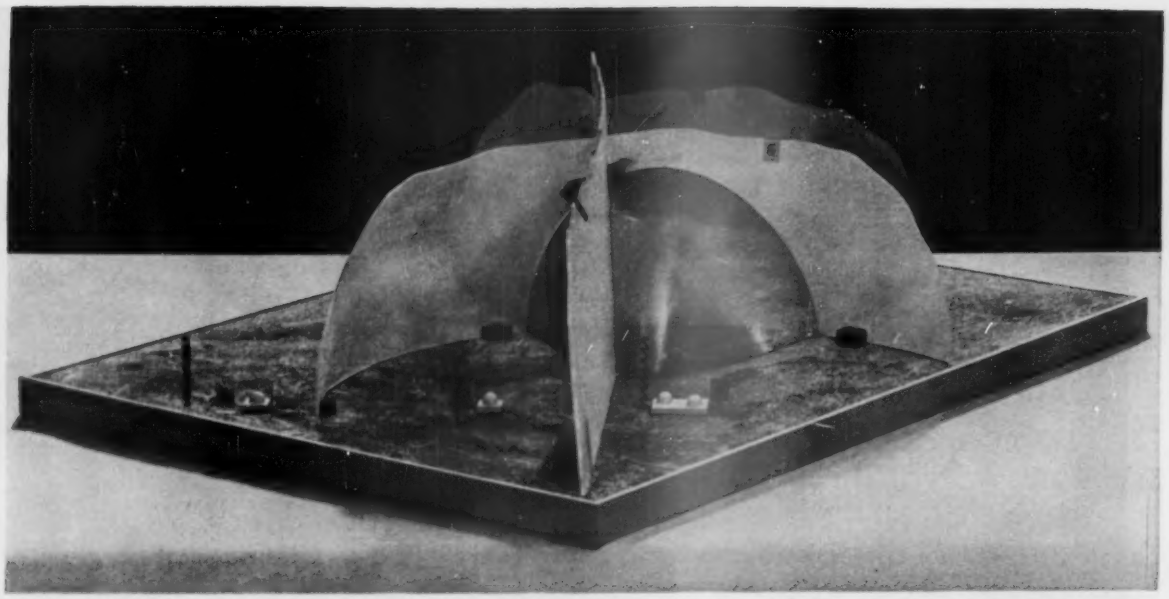


Moisture-resistant and low cost Dilecto cams for automatic washer and dryer controls.

Dimensionally stable, light weight, oil-resistant Dilecto ball bearing retainer rings.

Easily fabricated paper-base, punching grade Dilecto precision switch insulators.



MISSILE TRAJECTORY MEASUREMENT SYSTEM (Mistram) will be built for Atlantic Missile Range by General Electric's Defense Systems Department. Model above shows five stations in the system, laid out in an L-shape with 10,000 ft. and 100,000 ft. spacing between stations in each leg. Range will provide coverage out to 1,000 mi. Curved sheets of plastic in the model, formed in hyperbolic and parabolic shapes, represent phase and timing measurements made by Mistram. The first Mistram installation is expected to be ready for its first operational tests early in 1962. The system does not require precision tracking antennas but does use a low-accuracy radar which tracks the missile and provides signals for orienting receiving antennas at each of the stations.

Missile Position-Finding System Detailed

By Philip J. Klass

New York—First details on a new precision missile trajectory measurement system scheduled for Atlantic Missile Range, which is expected to be considerably more accurate than systems now in use, were disclosed here last week by General Electric, which will build system for the Air Force.

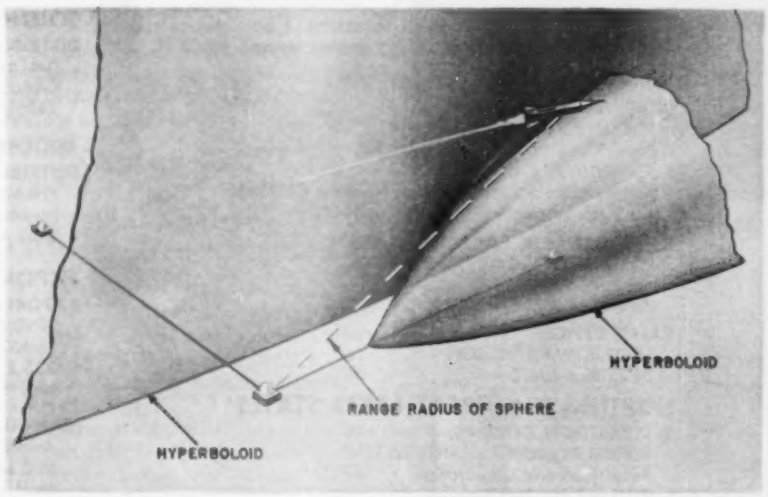
USAF's new missile trajectory measurement system, known as Mistram, is an outgrowth of the radio command guidance system developed for use with Atlas ICBMs by GE's Defense Systems Department. Mistram is to be installed at AMR next year.

Initial Mistram installation, scheduled to begin first operational tests early in 1962, will provide hemisphere coverage over a distance of more than 1,000 mi. Initial installation will consist of a central station at Cape Canaveral plus four remote stations laid out in the shape of an "L." Two inner remote stations on each leg of the "L" will be spaced 10,000 ft. from the central station, while outlying stations will be 100,000 ft. distant, or approximately 20 mi.

Accuracy of the Mistram system is not disclosed for reasons of military security. However, the velocity error of an ICBM must be held to less than 0.01% if the missile is to hit within one mile of its target (AW June 16, 1958, p. 217). Therefore any system designed to check ICBM guidance must have somewhat better accuracy than the system being tested by at least a factor of 5:1.

Accuracy of the initial five-station system can be increased through the installation of additional remote stations at greater distances down-range and along the Atlantic coast, GE says. Such an extension is planned for the future.

Basic technique used to determine missile position and velocity is by meas-



MISTRAM TRAJECTORY measurement system determines distance to missile from central station and difference between this distance and missile's distance to each of four remote stations (two of which are shown above). The distance-to-central station measurements describe a sphere (dotted white line) while each of the distance-differences describe hyperboloids of revolution. Intersection of the three (shown above) establishes missile's precision position. Missile is equipped with transponder.

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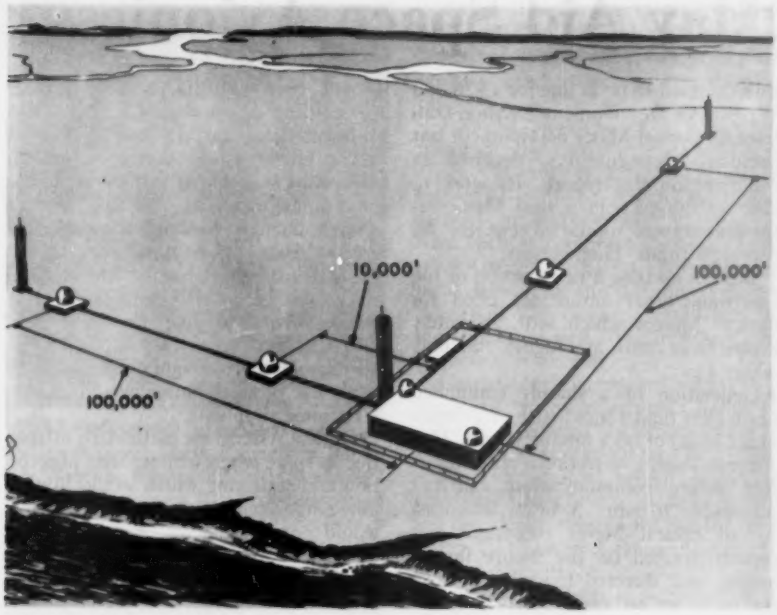

MISTRAM installation initially will consist of central station plus four remote stations layed out in shape of an "L," with two of the remote stations roughly two miles out and other two situated approximately 20 mi. distant. Later plans call for additional remote stations to provide greater accuracy.

uring the relative phase of signals received at each of the stations from a radio transponder beacon carried in the missile. The missile's velocity is determined by measuring rate-of-change of its position, rather than by doppler shift technique employed in the original Atlas guidance system.

Establishing Position

Missile position is established by measuring its distance from the central station and the differences between this distance and the missile's distance from each of the four remote stations. Distance measurements are made using a continuous-wave (CW) carrier and "extremely high effective modulation frequencies," GE says.

The distance measurements made from the central station describe a sphere, while the distance difference measurements made by remote stations describe a hyperbola of revolution. The intersection of the sphere and two hyperbolas of revolution provided by two of the remote stations are sufficient to define the missile's position in space, but the two additional hyperbolas provided by the other two remote stations serve to improve over-all system accuracy. Subsequent installation of additional downrange and up-coast remote stations can provide still better accuracy.

Mistram will incorporate new phase stabilization techniques which make it feasible to use extremely long baselengths for locating remote stations, overcoming a previous limitation of such interferometer type measurement systems, according to GE. The new technique, developed by company's Dr. Lewis J. Neelands, permits almost indefinite extension of system baselength, GE says.

The new system does not require precision tracking antennas, but does employ a low-accuracy radar which tracks missile and provides signals for orienting receiving antennas at each of the stations.

Inherent accuracy of a system such as Mistram depends upon the precision with which each station location can be determined. In addition to using conventional surveying techniques, Mistram should be able to obtain extremely accurate measurements of station base lines using signals from geodetic/navigation satellites, GE says.

Center Will Analyze ICBM Infrared Radiation

Ballistic Missile Radiation Analysis Center will collect, analyze and correlate data about infrared radiation emitted by ICBMs and IRBMs in an effort to develop mathematical models describing missile behavior.

Comparison of similar data from an unknown missile with the model could then help identify the missile. The Center is located at the Infrared Laboratory of the University of Michigan's Willow Run Laboratories in Ann Arbor, and is supported by $360,000 in Advanced Research Projects Agency funds from a contract with the Air Force's Geophysics Research Directorate.

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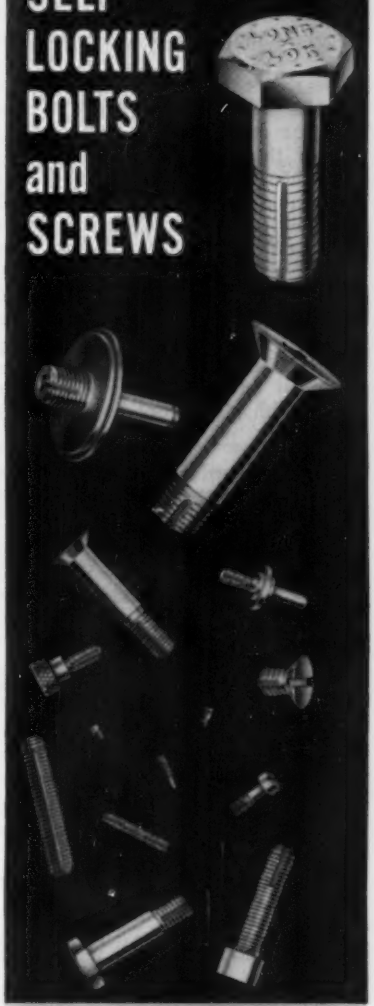

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Optical Maser May Aid Space Avionics

By Barry Miller

New York—Operation of a pulsed optical Maser recently announced by Hughes Aircraft Co. (AW July 11, p. 38) is expected to be an important initial step in developing practical optical space communications and radar systems.

For the first time, the Hughes Maser provides a source of coherent electromagnetic radiation in the optical portion of the spectrum at wavelengths, or frequencies, many times greater than those now generated by conventional electronic techniques. As such it throws open a different region of the spectrum for active systems and promises to give the designer a potential multi-purpose device (oscillator, amplifier, even a detector) for space avionic systems, Hughes' spokesmen maintain.

Largely on the strength of its early success with a laboratory model, Hughes is understood to be in line for a $70,000 Wright Air Development Division contract for optical Maser development but company representatives, declined to comment on this report. Its work to date on the year-old optical Maser development was supported entirely on company funds, Hughes says.

Besides opening a new portion of the spectrum, other advantages cited for optical Masers which will ultimately evolve from work at Hughes and elsewhere are:

- **Generation of a sharply collimated** beam (less than a hundredth of a degree of arc wide) of high intensity light. This suggests highly directional and therefore secure communications, all but impossible to jam. A beam broadcast by an optical Maser communication system situated on the moon, for example, and directed toward a receiver on earth or an earth satellite would probably not disperse over an area greater than 100 mi. thereby giving assurance of signal receipt security. By contrast, the beam of a quality microwave system would cover the earth, permitting possible reception at undesired points.
- **High angular tracking accuracy** for optical-Maser radar, sometimes called LIDAR, for light detection and ranging (AW Dec. 14, p. 87).
- **Insensitivity to free electrons** produced by radioactive blasts.
- **Probable light weight,** due to relatively low power requirements.
- **Extreme simplicity.**

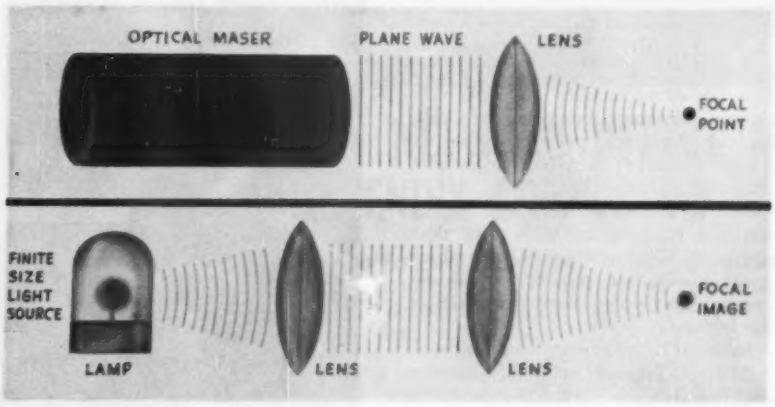
Optical systems are particularly attractive in space where atmospheric absorption and scattering which would hinder long-range terrestrial optical systems would not be a factor. Further development of optical Masers and systems as well as the need to find ancillary acquisition techniques for these systems are formidable obstacles which must be hurdled before practical optical systems become a reality.

For engineers familiar with microwave Masers, with their cavity or traveling wave structures, liquid-helium cooling devices and magnets, the Hughes optical Maser is an extreme contrast. It consists simply of a cylindrical rod of ruby, surrounded by a specially-prepared, spiral, high-intensity discharge lamp, all snugly fitted within a cylindrical housing, similar in size and shape to a can of frozen orange juice. Cooling of the device is unnecessary because the noise saving would be negligible. A magnetic field is needed only for tuning (device is tunable over 100 kmc.).

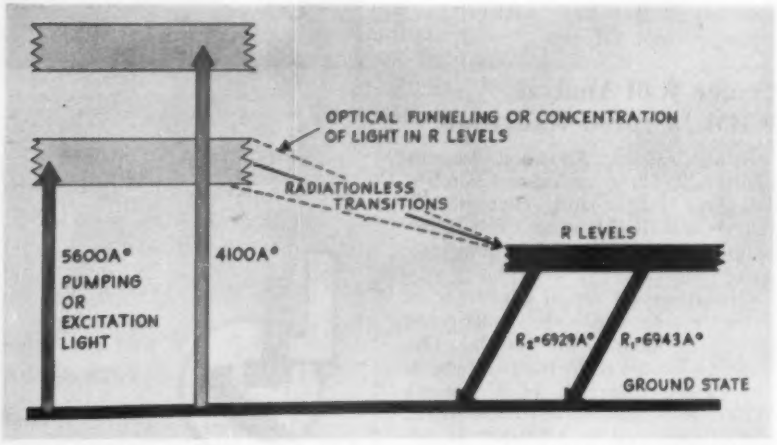
Upon excitation from the light flash, the Maser produces a one millisecond, 10 kw. peak-power pulse at 6,943 angstroms (this is approximately 430 megamegacycles). Pulse repetition rates, according to Theodore Maiman, senior staff scientist in charge of the development at Hughes Research Laboratories, are limited by heating of the flash tube to one pulse every 30 to 60 sec.

To be more generally useful an optical Maser would have to be a continuous wave device, and Hughes, like others working in this field, is looking toward such devices. A fully developed pulse optical Maser might have limited applications, perhaps in radar or in pulse position modulation communication systems, Maiman points out. Ultimately, he says, these will have to be continuous wave systems.

Hughes is only one of a number of organizations known to be actively working on optical Masers. Others include Bell Telephone Laboratories, Columbia University, Technical Research group, Martin, General Electric



COHERENT EMISSION of light from an optical Maser can be brought to a sharp focus unlike light from an incoherent source, whose waves are out of phase and unable to be focused to a point.



GREEN LIGHT from a flash source excites atoms of chrome-doped aluminum oxide to higher energy level from which they drop to metastable state before emission. Output is at 6,943 angstroms, roughly 430 megamegacycles.

RUBY ROD surrounded by spiral flash which serves as energy source is examined by Dr. T. Maiman, Hughes Aircraft Co. Hollow cylindrical aluminum housing fits over spiral to form optical Maser, about the size of a can of frozen orange juice.

and Westinghouse. Varian and General Precision are understood to be studying the feasibility of these devices preparatory to launching their own programs.

Columbia and Technical Research Group programs are government sponsored. Air Force funds are behind the Columbia program while the Technical Research program only recently received a $2 million extension of its one-year-old, $1 million work sponsored by the Advanced Research Projects Agency through the Air Force Office of Scientific Research.

Operation of the optical Maser depends on the interaction of atoms in matter. The ruby sample (aluminum oxide with chromium impurities) absorbs energy when flooded by green light (5,600 angstroms) from the discharge lamp. Atoms within the crystal are excited to a higher energy state. Photons are then reflected back and forth between silver deposited reflecting plates at the ends of the ruby cylinder and atoms are stimulated to radiate in phase or in a very narrow band. This contrasts with ordinary light sources in which atoms radiate in random directions, the latter being characterized as incoherent radiation.

Light is emitted parallel to the axis of the cylinder and through a small hole in one of the reflectors. If the Maser was used as an amplifier, the signal to be amplified could be fed through another hole in the opposite reflector.

Coherence of the emitted light, that is the band of frequencies over which the oscillator emits energy, is less than an angstrom. This could be improved, Maiman says, with different cavity design or by cooling the device to liquid nitrogen temperature (which would narrow the line by a factor of 25). Coherence expressed as the ratio of stimulated to spontaneous emission in 4:1.

Future Hughes work on the device will center on studying and increasing coherence, improving cavity design and seeking new materials, according to Hughes.

Ruby is only one of a number of possible active media for optical Masers. Hughes is studying other solids, including other synthetic gems. Other laboratories are working with gaseous systems such as cesium (Columbia, Technical Research), mercury-krypton (Technical Research) and helium combination (Bell Laboratories). Solids are being studied at Bell, Westinghouse, and Technical Research.

Concept of the optical Maser was suggested two years ago by Charles H. Townes, Columbia University professor and former consultant to Bell Telephone Laboratories, and Arthur Schawlow, Bell Laboratories. A basic patent for the device was issued to the two earlier this year and rights assigned to Bell Laboratories.

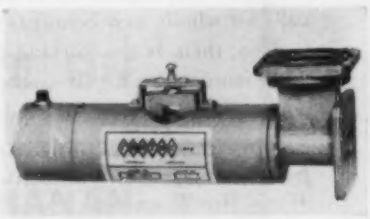
The optical Maser is also referred to by the term Laser—an acronym for Light Amplification by Stimulated Emission of Radiation. This prompted one scientist, unhappy about the easy use of freely coined names, to quip that the optical Maser is primarily an oscillator rather than an amplifier and might better be called a "Loser."

NEW AVIONIC PRODUCTS

Test Equipment

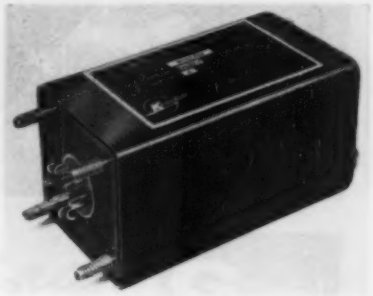
• **Voltmeter,** Model 411A, with voltage range of 1 millivolt to 10 volts, can measure small voltages to 1 kmc. with convenience and accuracy associated with audio frequency measurements, according to manufacturer. Meter has seven 3.6 ranges, 1 mv. to 10 v. and includes a decibel scale for readings from −42 to +33 db. Accuracy is ±3%, 1 mc. to 50 mc., and ±6% from 50 mc. to 150 mc. Five probe tips are included. Hewlett Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.

Components & Devices



• **Ferrite switch,** Model SX-102, for 9 to 10.2 kmc. band, provides 25 db. minimum isolation and less than 1 db. insertion loss and can switch in 0.1 microsecond. Unit sells for $550 each in small quantities. Rantec Corp., Calabasas, Calif.

• **Amplifier/Demodulator,** Model M3102-02, converts 400 cps. to d.c. This model consists of a 400 cps. preamplifier followed by a phase-sensitive demodulator. It is sealed and constructed to meet shock, vibration and environmental requirements of MIL-E-5272B. Power input is 27 ± 2 volts



d.c., 20 ma. maximum, 115 v.a.c., 400 cps. ±5%. Input signal is 400 cps. ±5%, 1 v. rms. maximum. Output is 1.3 ma. d.c./v. rms. a.c. into 500-ohm load. Power gain is 16 db. and linearity is ±5% to 0.15 v. rms. max. Unit weighs up to 6 oz. Kearfott Division, General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

• **Tantalum capacitors,** Types TSP 1 and TSP 2, are small size 50-v.d.c. solid electrolytic units. TSP 1 measures 0.125 in. diameter and 0.25 in. long and has capacitance range of 0.33 to 0.82 microfarads for full voltage rating at 85C while TSP 2 is 0.172 in. in diameter and 0.438 in. long with 2.2 to 5.6 microfarads rating for 50 v. at 85C. Tolerance on each capacitor is ±10%; first component weighs ½ gram while the second is 1.2 grams.

• **Signal Simulator,** Model 145B, provides means for simulating PAM and

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Since Creation, man has looked out on space. At first, unknowing and incurious; then with the beginnings of understanding; now free and able to explore. Yet to move in space calls for wholly new concepts of energy.

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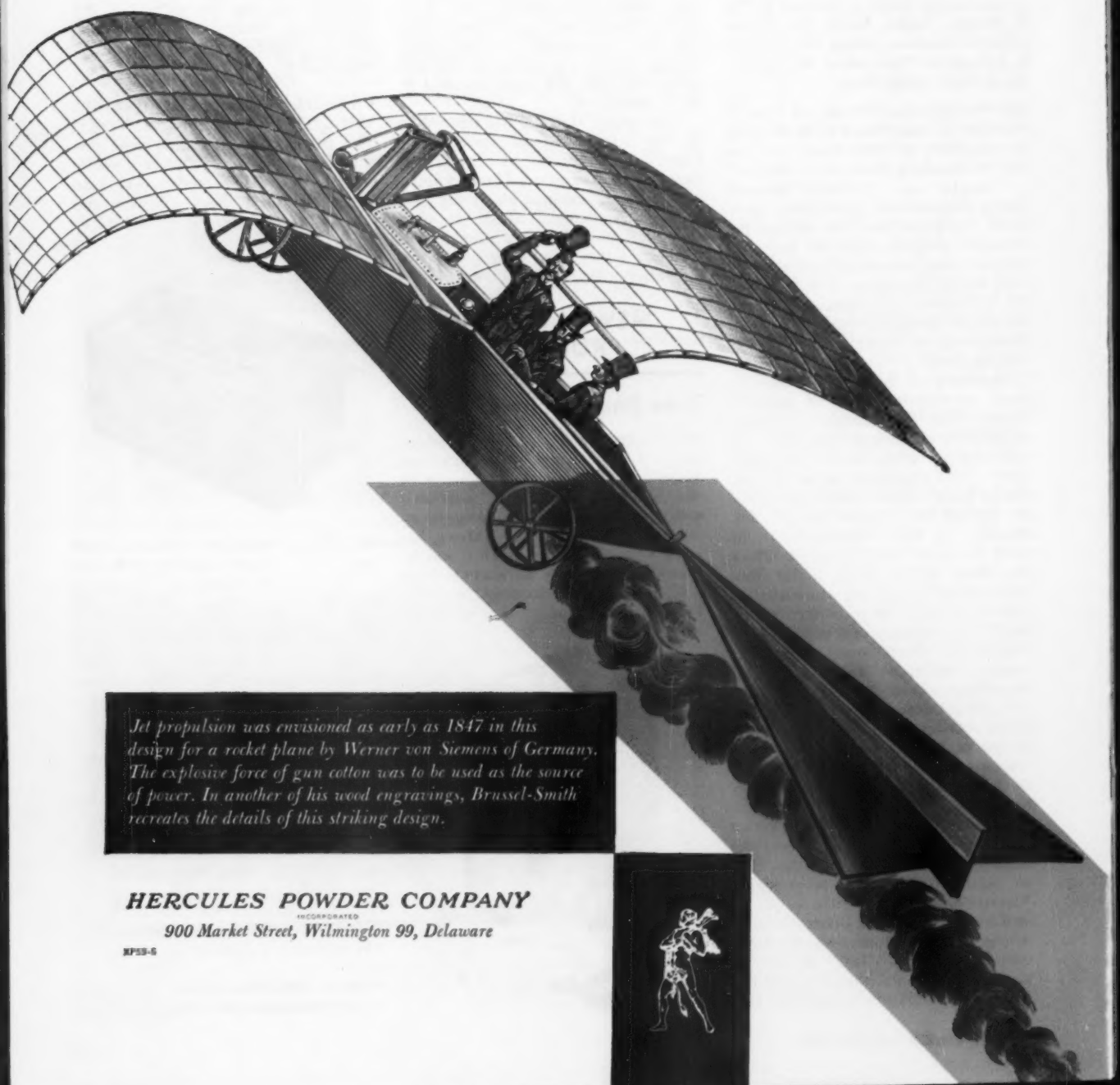

Jet propulsion was envisioned as early as 1847 in this design for a rocket plane by Werner von Siemens of Germany. The explosive force of gun cotton was to be used as the source of power. In another of his wood engravings, Brussel-Smith recreates the details of this striking design.

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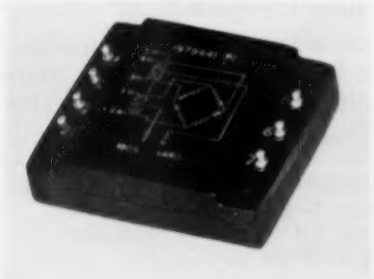
PDM pulse trains for checkout, calibration and evaluation of telemetry decommutation equipment. Simulator also can generate non-standard signals for future telemetry commutation modes and can simulate data-transmission faults like missing channels, commutator speed variations, duty cycle variations, tape flutter, noise, and fading. Ten through 100 channels/frame, standard commutation rates from 75 to 900 channels/sec. and 40 to 90% PAM duty cycle can be selected. Electro-Mechanical Research, Inc., Sarasota, Fla.

• **Crystal filters,** No. BP-10000-40, is 10-mc. center frequency band-pass precision filter developed for use with transistorized IF amplifiers and packaged in hermetically-sealed unit capable of withstanding 50g shock. Filter has 36 kc. bandwidth at 6 db. points and 80 kc. at 60 db. Ripple is ½ db. and stopband rejection is 70 db. for filter packaged as ½ in. x 1¼ in. x 2 in. unit. Systems, Inc. 2400 Diversified Way, Orlando, Fla.

• **Demodulator/Phase Detector,** Model 1806, for use in data transmission, error sensing, servomechanisms, autopilots and guidance systems, provides d.c. output proportioned to any amplitude/phase difference between the 35 volt, 800 cps. reference input and zero to 25 volt, 800 cps. signal input. Noise is 10



millivolts maximum for 500-ohm resistor connected to input terminals and 35 v. rms., 800 cps. applied to reference. Drift is ±2 millivolts rms., 20 to 85C for constant 35 v. rms., 800 cps. signal applied to reference and constant 10 v. rms. 800 cps. applied to input. Varo Mfg. Co., Inc., 2201 Walnut St., Garland, Tex.

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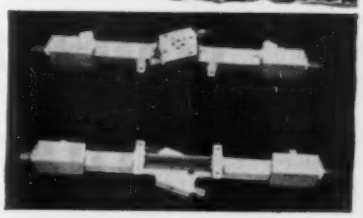

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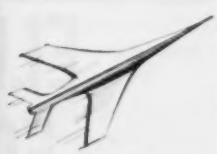

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For further information, write, wire or phone Preliminary Design Engineering Dept., FMC Ordnance Division, P.O. Box 367, San Jose, California. Phone: CYpress 4-8124.

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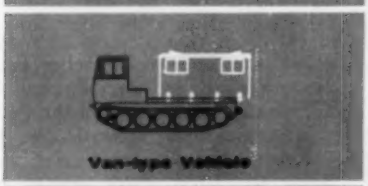
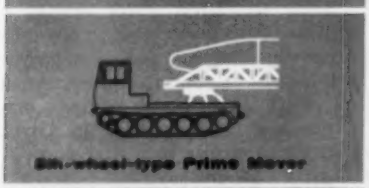
Illustrated below are the M-113 and five vehicle adaptations of this basic tracked vehicle. All of the vehicles use the same military standard equipment, including engines, power train, and suspension components; thus reducing the military logistic burden and R&D costs in weapons systems.





FMC's New Liquid Propellant Metering System Achieves Accuracy to ±0.1%

Mobile metering and control unit for fueling liquid propellant missiles.

The crucial reliability of multistage missiles is influenced by the accurate measurement and delivery of liquid propellant to the missile tanks. For example . . . a small error in fuel weight could adversely affect the in-flight performance of the missile, causing possible failure of the entire mission.

Food Machinery and Chemical Corporation's Ordnance Division has recently developed a mobile liquid propellant metering and handling system which promises to solve many missile fueling problems. The advantages offered by this unique new system are many.

Accurately measures and records the amount of fuel delivered to the missile tanks. Original specifications called for a metering accuracy of ±0.2%. Extensive tests, recorded by precision test equipment, show that the system is capable of metering and delivering missile propellants with far superior accuracy—to ±0.1%.

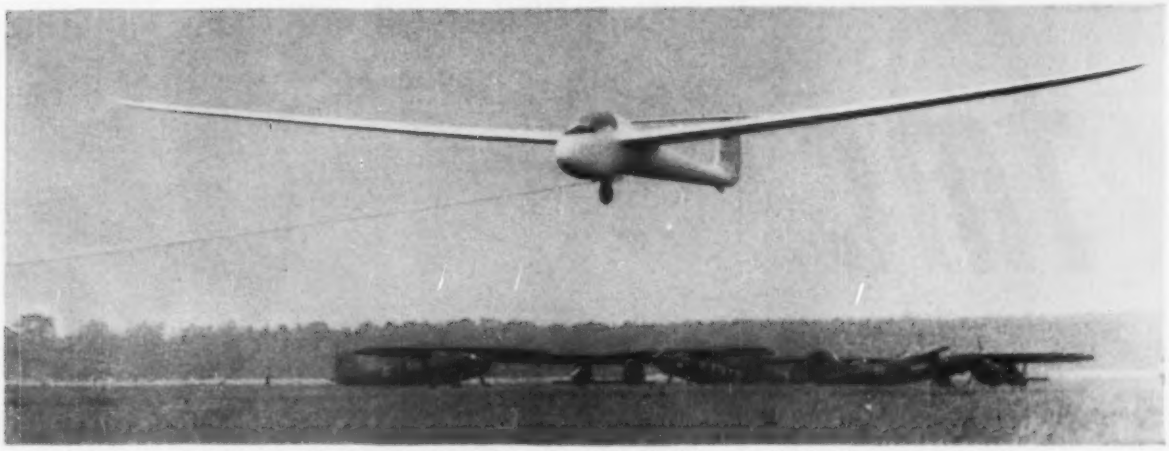
Automatically compensates for factors influencing fueling accuracy. The fuel is continuously sampled and the flow corrected for variations in temperature and density. In addition, the fuel which vaporizes in the missile tanks is returned to the system, condensed, measured, and an equivalent amount added by the metering unit.

Adaptable to many different missile fuels. The system is designed to handle such storable liquid propellants as hydrazine, nitrogen tetroxide, Dimazine® (UDMH) and nitric acid.

Economical to manufacture and safe to operate. To reduce development, manufacturing and operating costs, the system makes maximum use of standard, interchangeable, and commercially available components. The simple and safe design eliminates human errors and danger to operating personnel.

Mobile and compact. All metering, pumping and control equipment is mounted on a single, portable trailer. The complete unit may be easily transported, rapidly positioned, and provides a single station for the monitoring of fueling operations.

The successful development of this mobile metering and handling system by the engineering staff of FMC's Ordnance Division is another achievement made possible by utilizing the unique combination of chemical and mechanical engineering talent available at Food Machinery and Chemical Corporation.



MODIFIED German FS-24 Phönix glider flown by Ernst-Günter Haase of Poland has new T-tail and retractable landing gear.

World's Gliders Vie in West Germany

By Edith Walford

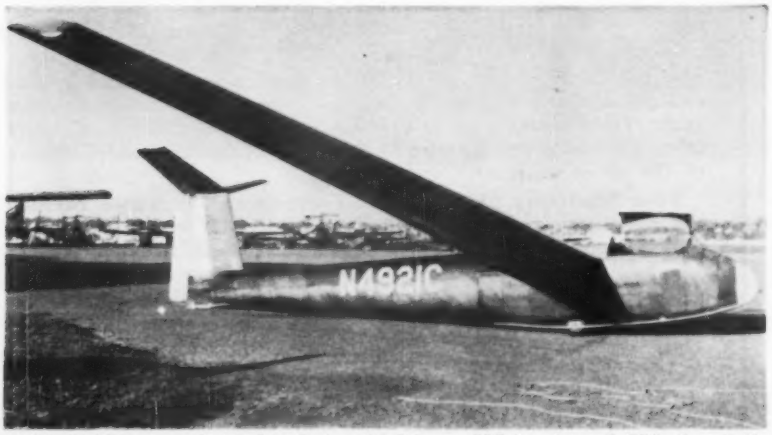
Butzweiler, West Germany—West Germany's Heinz Huth and Argentina's Rudolpho Hossinger took top positions in standard and open class respectively at the Eighth World Gliding Championship here.

George Münch, Brazil, and Adam Witek, Poland, took second and third places in the standard class. Two other Polish pilots, Edward Makula and Jerzy Popiel, placed second and third in the open class. Names of second and third place winners in both classes were reversed in a previous report (AW June 27, p. 35).

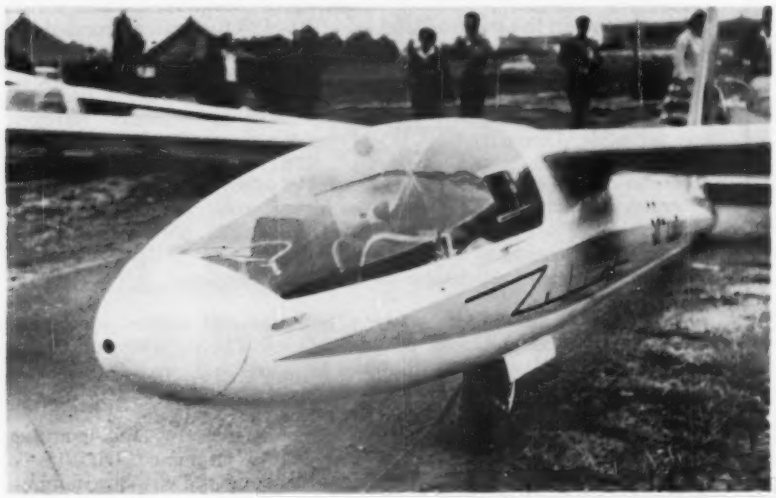
The two-week contest, which was preceded by a one week practice period, was organized by the German Aero Club under the auspices of the Fédération Aeronautique Internationale, Paris.

Represented by top-ranking pilots flying the latest glider designs from many of the 24 countries represented, it was the toughest, most comprehensive international gliding contest ever held.

First international soaring competition was held in 1937 in Germany, cradle of gliding.



RHJ-6 ADASTRA was designed by Richard H. Johnson, U.S.A., who took 15th place in the open class. Adastra's span is 58 ft., length is 25.4 ft. and wing area is 163.5 sq. ft.



SZD-ZEFIR took second place in the open class, flown by Edward Makula of Poland. Its exceptionally sleek, clean lines evoked favorable comment. The Zefir has a 55.8-ft. wingspan, measures 23.1 ft. in length and has a wing area of 150.6 sq. ft.

Glider Restrictions

Two classes, open and standard, were admitted to the competition this year. The open class is subject to no restrictions and pilots may use radio. Gliders in the standard class may not have a span exceeding 49½ ft. (15 meters), and retractable landing gear, variable wing area or section, and use of radio equipment are excluded.

Twenty gliders were entered in the open, 35 in the standard class. Originally, 27 countries with a total of 67 gliders entered the contest. But of the

five Iron Curtain countries expected, only the Polish team and one of the three Yugoslav pilots actually arrived.

The organizers requested all pilots to obtain in advance visas for every country bordering on West Germany, to provide security in the event a forced landing or infringement of flight regulations brought any of the participants beyond the German frontiers during the contest.

Soviets Protest

The Russians claimed inability to obtain visas in time. They also protested against the employment of "military aircraft"—25 Do-27s on loan from the German Luftwaffe and other army units for towing purposes. The German Aero Club replied that nobody in West Germany other than military authorities could put such a large fleet of tow-planes at the disposal of the Butzweiler meet, and that in any case this was in accordance with normal practice of other countries on such occasions.

The Hungarians explained they were unable to come because they had not completed construction of the new sailplanes they were hoping to introduce at the Butzweiler meet.

Neither the Czech team nor the two missing Yugoslav pilots excused themselves, but it was generally assumed they had found participation too expensive. Business at home prevented the one Canadian pilot, Oates, from coming.

Required Missions

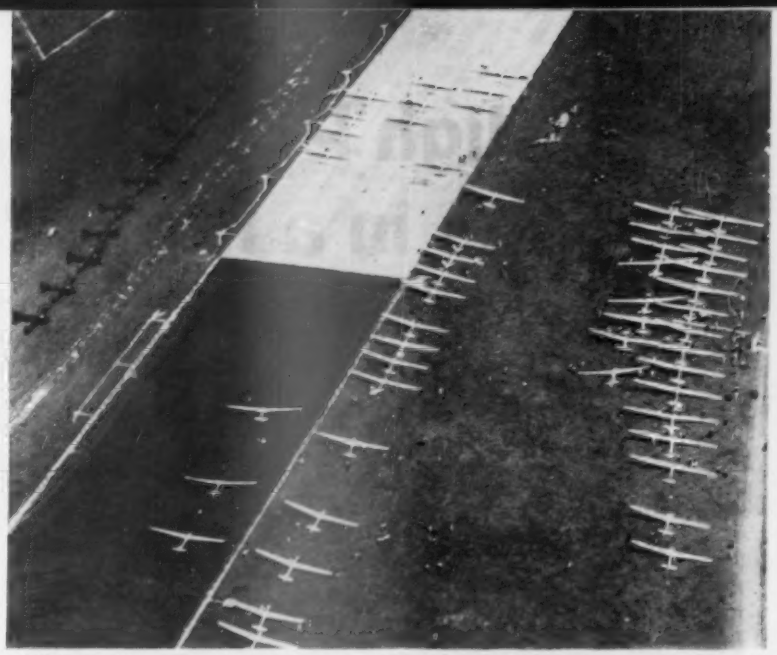
In accordance with FAI Gliding Commission rules, a specified mission was scheduled on certain days of the contest for each of the two classes of gliders, weather permitting. Obligatory tasks included a free distance flight in any direction as well as a goal or out-and-return race, and a distance contest over either 100, 200 or 300 km. with no intermediate landings.

Gliders were launched by the 25 Dornier Do-27 aircraft in quick succession on the six days to which unsuitable weather limited the competition.

Leader in the open class by the end of the first week's flying was Britain's Nicholas Goodhart in his Elliotts Olympia 419 sailplane. He led on two of the six days of competition, but subsequently lost points for admitted cloud-flying on one occasion and voluntarily withdrew.

He placed fourth with 4,856.6 points in the final results.

The first week's performance had stressed the apparent superiority of the Polish trio with their new, sleek, high performance Zefir (open class) and Foka (standard class) sailplanes. Their seemingly effortless lead by the end of the fourth day was an indication to most



LINEUP on the opening day of the 1960 Eighth World Gliding Championships at Butzweiler near Cologne, West Germany. Dornier Do-27 tow-planes are at upper left.

POLISH SZD-FOKA was piloted by Adam Witek to third place in the standard class. Reduced height of the Foka requires the pilot to lie in the cockpit. Breguet-905 Fauvette (below) was flown by Julio Arteman, Argentina, in the standard class. Span of the Fauvette is 49 ft. 2 in.; over-all length is 20.2 ft.; wing area is 121 sq. ft.

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Units in stock cover the frequency range from 500 kilocycles to 1000 megacycles—provide power outputs from one watt to 50,000 watts. Larger powers (up to 500,000 watts) can be obtained by paralleling units. Pulsing or modulation can be provided as needed.

Where units of other powers or frequencies are required—or where requirements of a very specialized nature must be met—RCA engineers have the know-how and experience to custom-build to your specifications. Recent projects include applications in the fields of fusion power, particle acceleration, ion propulsion, plasma heating, propagation studies and satellite tracking.

Whether your requirements can be filled by off-the-shelf items or by custom building, you can benefit from RCA's broad experience. Write to RCA, High Power Electronics and Nucleonics, Dept. JC-18, Building 15-1, Camden, N.J.

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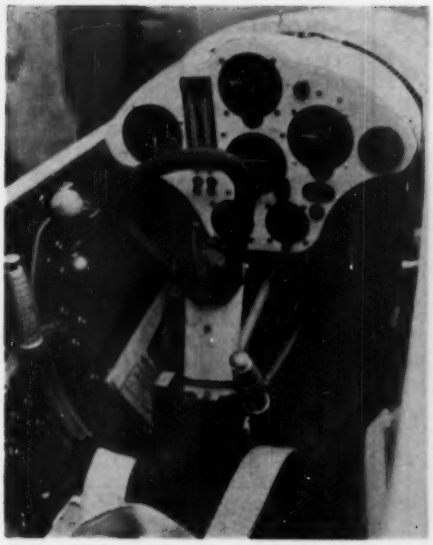


INSTRUMENT panel of the all-metal Yugoslav Meteor 60 is shown at left. The plane, built in 1956, was flown at Butzweiler championships by Jose Mrak, the only member of the Yugoslav team to appear at the competition.

spectators that the Polish pilots would pocket both championship titles. The ultimate victory of Rudolpho Hossinger, 30-year-old transport pilot of the Shell Oil Company in the Argentine, was consequently quite unexpected.

Standard Class Title

Ernst-Günter Haase, 1958 open class world champion at Leszno, Poland, flying for the first time a modified version of the all-synthetic FS-24 Phönix glider first introduced at the German Gliding Championships at Karlsruhe-Forchheim last year (AW Aug. 17, p. 119), was only ninth with 4,001.9 points. Among other slight changes, the Phönix is now fitted with a T-tail and retractable landing gear.

Throughout the contest the main struggle for the standard class title was between Adam Witek of Poland, 1958 standard class world champion at Leszno, and German champion Heinz Huth.

The Kaiser Ka-6 BR, in which Huth finally won the event, took all five top places in the standard class this year.

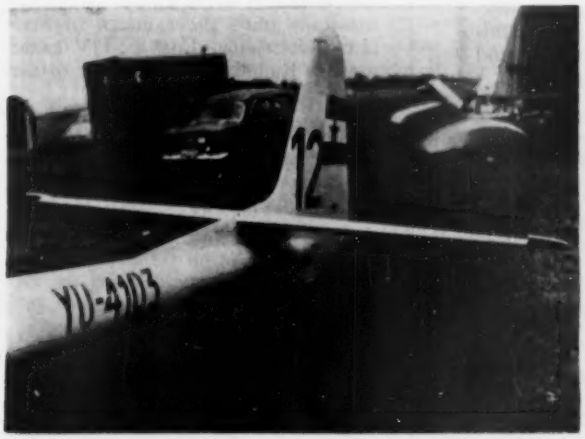
In the opinion of the German Aero Club, it was not the U. S. team's lack of skill that placed the three pilots only 12th in the standard, 15th and 16th in the open class of the final results. Some European experts present believed that the light German thermals are unsuitable for most American sailplane designs. They do much better at home where they can fly higher and further over wide open, usually sandy terrain in more stable weather. A contest held in the U. S. including some of the best European glider types would soon prove this point, they said.

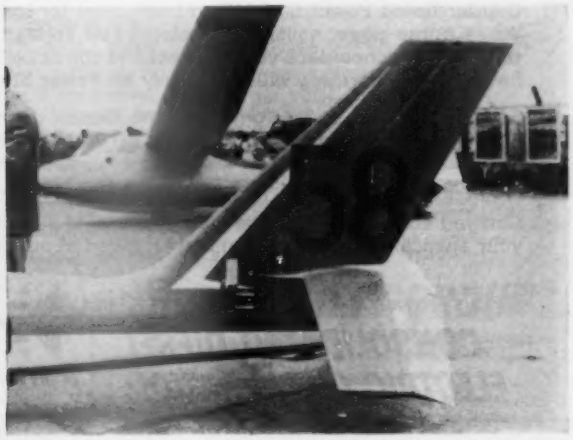
The U. S. team's captain was Paul A. Schweizer, vice president of Schweizer Aircraft Corp., Elmira, N. Y. Richard H. Johnson, holder of the 535-mi. world distance record and U. S. soaring champion five times, totaled 2,992.2 points in the open class in a new, T-tail RHJ-6 Adastra sailplane of his own design.

Self-Designed Glider

Richard E. Schreder, U. S. A., scored 2,891.4 points in the open class in his self-designed Air Mate HP-8 glider. Schreder is holder of all three official open class world speed records for 100, 200 and 300 km.

Third American pilot was Paul Bikle, head of the National Aeronautics and





TAIL SECTION of the all-metal Yugoslav Meteor 60 is shown at left. Tail section of the new standard class SZD-Foka, a Polish entry, features a swept vertical surface (right). SZD-Foka span is 49 ft. 2 in., length is 23.6 ft., and wing area 130.8 sq. ft.

"The approach was normal. The pilot reported over the middle marker. We had radar and voice contact. We were just about to advise him that he was low on the glide path when we suffered a power failure. In five seconds we were back on the air, but there was no target on the scope. There was no answer to our call. There was no plane on the runway."

This could have been an altogether different story if the Condec's Uninterrupted Power Supply had been used for standby power. When prime power fails, **UPS** restores **Full Voltage** in 1.5 **Milliseconds.** Radar contact, voice contact and corrective action could have gone on normally with absolutely **No Power Stoppage.**

Power insurance in the form of these diesel-driven generating units is available in capacities from 10 to 200 kilowatts. The engine turns over only when it's needed . . . operating and maintenance costs are negligible.

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Competition Score

Of the 55 entries in the 1960 World Gliding Championship, 20 competed in the open, 35 in the standard class. Final results were:

Open Class	
R. Hossinger, Argentina (Slingsby Skylark III)	5,102.9 pts.
Edward Makula, Poland, (SZD-Zefir)	5,079.1 "
Jerzy Popiel, Poland, (SZD-Zefir)	5,020.7 "
Standard Class	
Heinz Huth, Germany, (Kaiser Ka-6 BR)	5,619.1 "
George Münch, Brazil, (Kaiser Ka-6 BR)	5,237.8 "
Adam Witek, Poland (SZD-Foka)	5,201.9 "

Space Administration High Speed Test Station at Edwards AFB, Calif. He flew into 12th position in the standard class, totaling 3,701.1 points in his SGS-1-23 glider. Bikle was the third U. S. pilot to earn the FAI three-diamond award in 1952 and he also held the Class D-1 200 km. world speed record from 1957 to 1959.

Winners Honored

The ceremony held on the Butzweiler airfield in honor of the first three winners in each class cited Austrian sailplane designer Rüdiger Kunz, who received the OSTIV trophy for the development of the new Standard Austria sailplane, one of 10 different designs entered for the award. Kunz started construction of the glider for the Austrian Aero Club last year and completed two models for the Butzweiler championships.

It is an all-white, V-tail glider of exceptionally graceful design and proved to be one of the fastest gliders at the meet.

The OSTIV trophy is awarded every two years for the simplest, most economically built glider design of first-rate performance. First OSTIV award went to Rudolf Kaiser, designer of the Kaiser Ka sailplane series, in 1958.

OSTIV Congress

The OSTIV (Organisation Scientifique et Technique Internationale du Vol à Voile) held its seventh congress simultaneously with the Butzweiler world championship competition from June 7-18 at Cologne. During the discussions, a total of 75 papers dealing with various aspects of aeronautical research were read. OSTIV also reached agreement on airworthiness requirements for standard class gliders, which are now to be recommended for acceptance by all other countries concerned.

FAA Intensifying Its Campaign Against Private Flying Accidents

Washington—Tighter qualifications for private pilot certificates probably can be expected in the near future as the Federal Aviation Agency intensifies its efforts to reduce an accident toll which last year cost 721 lives in 4,598 accidents.

While a certain amount of this 25% increase in accidents over the 3,399 recorded in 1958 can reasonably be attributed to the rapid growth of private aircraft operations, both FAA and the U. S. Weather Bureau point out that an estimated 60% of the fatal accidents can be traced directly to a combination of adverse weather conditions and lack of pilot knowledge of elementary instrument flying.

FAA's records of fatal accidents for aircraft weighing less than 12,500 lb. in 1958 show that weather figured in 109 of a total of 328 fatal accidents which claimed the lives of 640 pilots and passengers. To this total may be added 61 cases where pilots lost control in bad weather, plus multiple causes such as inadequate flight planning and flying into objects.

Steps to reduce this rate already are being taken by the Weather Bureau, which is increasing its automatic weather broadcasting and telephone answering service, and the FAA, which this year expanded private pilot certificate qualifications to include a demonstration that the applicant can successfully complete such basic maneuvers as 180 deg. turns and attitude control by means of instruments.

The new regulations also require the applicant to prove he is familiar with the use of radio equipment for cross-country flights.

FAA plans a September meeting to discuss further measures needed to eliminate many of the fatal accidents and an experimental program to test the feasibility of direct pilot-to-weather forecaster services.

Pilot Problem

FAA feels that psychologically, the roots of this safety problem lie in "misplaced trust" on the part of pilots who gamble with poor weather conditions in the mistaken belief they can rely on their radio and instruments to escape rough weather. This is particularly true in cases where the aircraft may be an advanced design, such as the twin-engine Beech Twin Bonanza, Piper Apache or Cessna 310, flown cross country or at night.

"While the aircraft is up to the job," one instrument flight instructor told AVIATION WEEK, "the pilot too often is not. The basic trouble is that the longer range, better instrumented and more powerful aircraft are just trickier to fly. Sunday afternoon fliers who have logged nothing but contact flying in the most basic type plane graduate into more sophisticated aircraft without first acquiring the additional piloting skills demanded by these planes. Seat of the pants flying proves useless in zero visibility and with no ground reference, survival becomes a matter of accurate reading of the instrument panel. As the fatal accident records show, too few private pilots bother to master at least the rudiments of instrument flying."

Weather Broadcasts

Within a year the Weather Bureau expects to have a network of 88 continuously transcribed weather broadcasts on the FAA general low- and medium-frequency radio facilities. Sixteen of these stations are now operating at major cities and provide a flying weather forecast, weather warnings, winds aloft, pilot weather reports and 10 or 12 weather reports covering a radius of about 250 mi. Forecasts cover an 8-12 hr. period and are brought up to date every 3 hr.

In addition, this same information is used for the Bureau's semiautomatic telephone answering service, estimated to accommodate around 80% of total pilot briefing. Under a joint FAA-Weather Bureau program, a supplemental briefing service also is being organized which will use 330 FAA broadcast stations to answer air-ground requests for weather information and to handle preflight briefings at locations where there is no Weather Bureau office.

While the Bureau's semiautomatic broadcasting and telephone service has drawn praise from private pilots, many feel it cannot answer the problem as well as a direct pilot-to-forecaster system, similar to that currently being used by the Air Force.

FAA is in the planning stage of examining such a system, but points out that its adaptation to civil use for light aircraft may raise difficult problems of getting new frequency ranges, adding or changing radio equipment at FAA stations and requiring private planes to complete installation of more complex radios.

Behind FAA's decision to expand private pilot qualifications was an "overwhelming" volume of evidence that most of these fliers can not read their instruments well enough to main-

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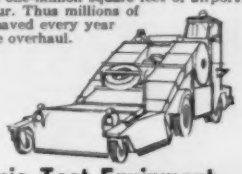
More than 100 of these runway vacuum sweepers have been built by the Aircraft Equipment Division. Each cleans one-million square feet of airport surfaces an hour. Thus millions of dollars are saved every year in jet engine overhaul.



Electronic Test Equipment

Automatic multiple circuit analyzers similar to the one shown have been built by Consolidated Avionics for major electronics and missile manufacturers. They search more than 2,000 points in a system and point out wiring errors and doubtful connections. It is one of many highly specialized electronic units produced by Avionics. Other products include data reduction systems and a complete line of transistorized power supplies.

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The Lima Electric Motor Co., Inc., Lima, Ohio

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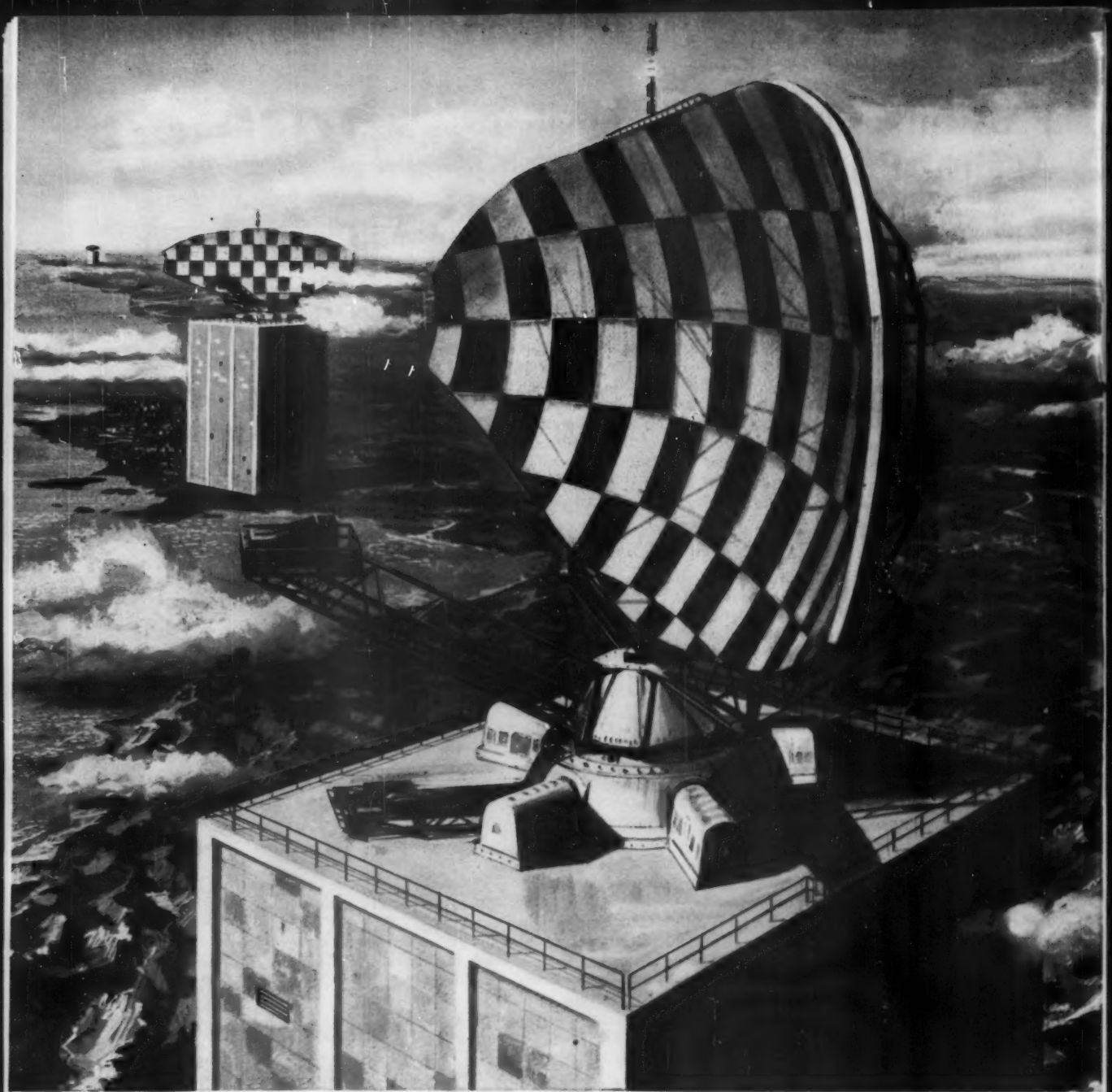

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SPERRY

tain the aircraft's basic attitude control in poor visibility conditions. The agency abandoned a proposal to expand flight experience requirements from 40 to 50 hr. for the private license in favor of the instrument training requirements, which were based on 1958 research conducted in primary flight training at West Virginia University.

In this project, conducted with the Link Foundations, students with no flying experience had an average of about 5 hr. dual instrument instruction as part of their primary training. This instrument training included straight and level flight, turns, climbs and descent, slow flight and stalls, recoveries from unusual attitudes and simulated GCA approaches in Cessna 140A and 170A aircraft. The idea of incorporating this instrument training was to avoid the old "seat of the pants" flight education, said FAA, and instructors who participated said students getting this instrument training were better flyers than the average student training in an all-contact flight program.

"There appears to be a psychological factor present since the new student seems to accept the instruments as a part of the airplane instead of a thing apart. In fact it was found that most of the students performed maneuvers more proficiently on instruments than when using visual references and preferred doing the maneuvers by reference to the instruments," according to one of the instructors in the program.

Training Study

A follow-up study conducted at the university last year involved students with previous flying experience and produced the conclusion that previous contact flying experience is of no value to the instrument flight student. Based on the earlier study, the report said such experience could be a disadvantage, and instrument instruction is best absorbed in the pre-solo stage of primary instruction. Instructors in the 1959 program found that the average certificated pilot can be taught to fly on instruments and execute the basic instrument maneuvers in less than 10 hr.

FAA's current regulations also include a minimum requirement of 10 hr. instrument flight experience, plus a demonstration of cross country flying, for a commercial pilot's license. FAA included requirements because the commercial certificate covers piloting aircraft for hire.

Inclusion of the instrument requirements does not qualify private or commercial pilots for instrument flight rule flying, but it is hoped that pilots complying with the new regulations will be encouraged to work toward an instrument rating.

Since the establishment of the FAA, the Civil Aeronautics Board has been responsible only for the investigation of fatal accidents involving aircraft weighing 12,500 lb. or less, but the Board keeps records and analyzes all aircraft accidents in this weight category. FAA investigates the non-fatal accidents and turns the reports over to CAB.

Accident Reports

Here are some examples of CAB accident reports which highlight FAA and Weather Bureau concern for the private pilot's instrument abilities:

On a VFR flight plan from Springfield, Mo. to Kansas City, Mo., the pilot of a Piper PA-24 deviated to Columbia, Mo., because of weather at Kansas City. At last contact, the pilot asked the status of the Columbia VOR, was told it was normal, and was given landing permission. The flight was reported missing and the wreckage was found two days later in an open field approximately 11 mi. east of the Columbia Airport. The Board's analysis found that the pilot, not qualified for instrument flight, flew into the ground in instrument weather and also had disregarded advice to postpone the flight in the face of existing unfavorable weather.

The pilot of a Beechcraft D-35, carrying three passengers, became lost while attempting to locate the Lexington, Ky., airport under below-VFR conditions at night. While trying to reach Louisville as an alternate, the aircraft crashed and burned in rolling terrain. The CAB pointed out that the pilot did not hold an instrument rating and

Aircraft, Parts Exports

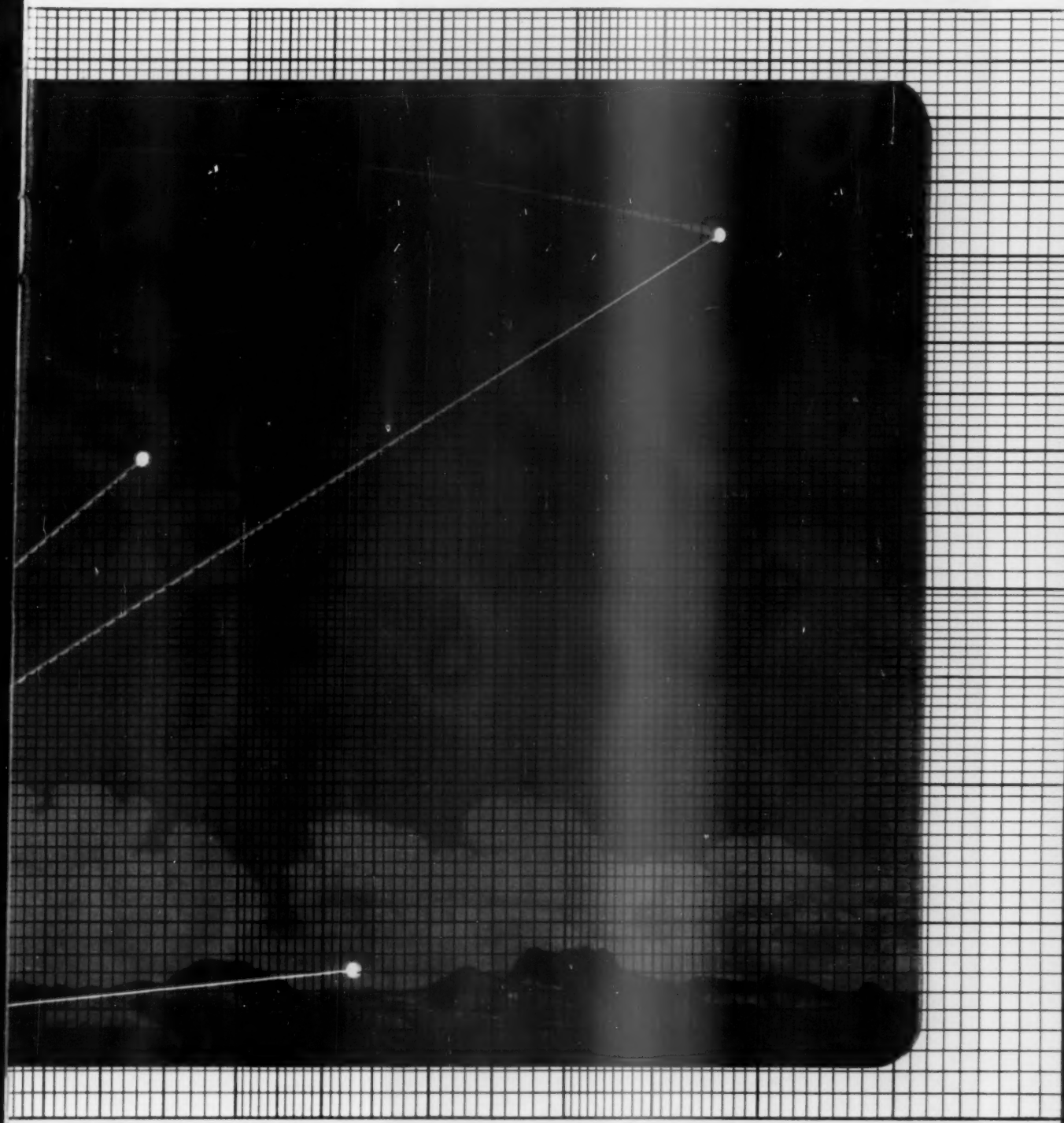
Exports of Aircraft, Parts, and Accessories from the United States: Quantity and Value February and March 1960

Item	March 1960		Cumulative totals Jan.-Mar. 1960	
	Number	Value ($1,000)	Number	Value ($1,000)
Aircraft, parts, and accessories, total	...	133,468	...	267,239
Commercial and civilian aircraft, total	195	48,079	474	81,934
Aircraft 3,000 lb. and over empty airframe weight:				
Cargo transports, commercial, new	...	...	...	...
Passenger transports, commercial, new:				
3,000-14,999 lb. empty airframe weight	2	308	11	1,412
15,000-29,000 lb. empty airframe weight	1	820	1	820
30,000 lb. and over empty airframe weight	8	43,332	17	70,934
Rotary wing aircraft, commercial, new	...	...	1	288
Commercial and civilian aircraft, used and rebuilt, including converted	10	1,261	31	3,002
Aircraft under 3,000 lb. empty airframe weight:				
Utility, commercial and civilian, new:				
3 places and under	31	255	85	676
4 places and over	105	1,732	239	3,981
Rotary wing, commercial, new	4	211	7	365
Commercial and civilian aircraft, used and rebuilt, including converted	34	160	82	456
Commercial and civilian aircraft, new, n.e.c. (all empty airframe weights)	...	...	...	...
Aircraft engines, reciprocating, new air-cooled under 400 hp.[1]	106	268	306	704
Aircraft engines, reciprocating, used and rebuilt	125	987	322	2,036
Aircraft components, parts, and accessories, n.e.c.[2]	...	84,134	...	182,565

Source: Foreign Trade Division, Bureau of the Census.

[1] Air-cooled reciprocating engines, new, 400 hp. and over are included in "Aircraft components, parts, and accessories."

[2] Includes military aircraft.



An entirely new Westinghouse radar technique now under development at the Electronics Division will sharply increase the accuracy of radar detection, identification and tracking of objects in space.

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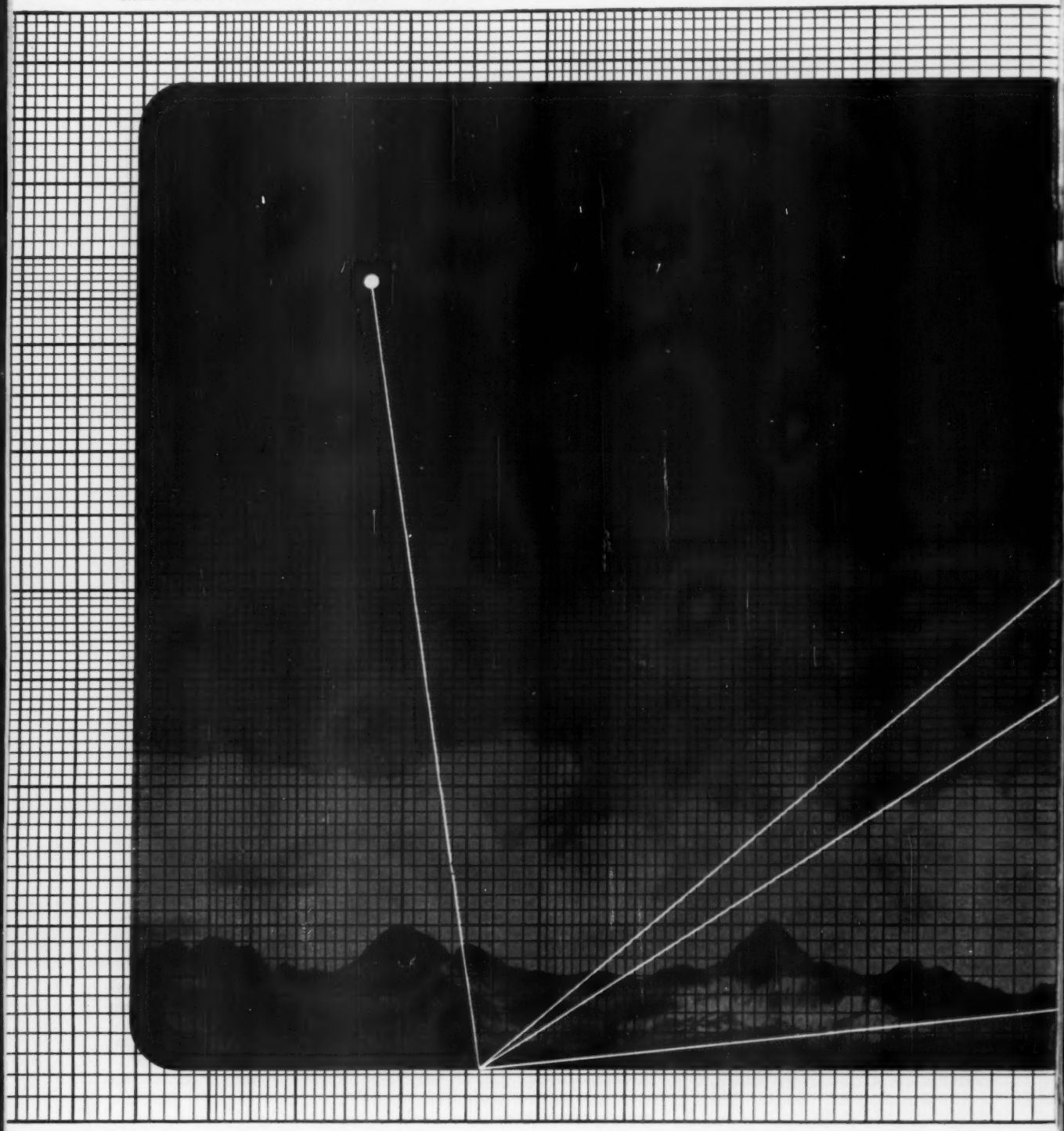

PRECISE MEASUREMENT IN SPACE... with New Westinghouse Radar Technique

mately 882 lb., span is 55.8 ft. and length is approximately 23 ft. Soviet press reports that the new craft compares favorably with the high-performance French Breguet 901 sailplane. Antonov's earlier A-11 sailplane has been strongly criticized for not meeting claimed performance.

Beech dealer buildup program (AW Feb. 22, p. 95) has accounted for adding 28 new domestic sales and service organizations to the company's roster thus far this year for current all-time high total of 119, with further increase continuing.

Volunteer Helicopters, Inc., Knoxville, Tenn., is a new rotary wing operation which has purchased a Bell 47G-2 for general charter, passenger, survey and other duties. Plans include service to transport air passengers from Knoxville Airport to downtown in six or seven minutes, compared with approximately 45 min. now required by surface means.

Full-year's warranty has been established by Tactair, Inc., on its "Gold Seal" T-3 three-axis automatic pilot, covering gyro instrument components as well as other items in the system.

Three Cessna 310D light-twin business planes have been ferried across the Atlantic for delivery to the company's dealers and distributors in England, Switzerland and South Africa. Cessna has formed a new marketing division for handling world-wide merchandising and marketing of all its commercial aircraft products. New division, managed by Frank Martin, will prepare for future sales expansion and new products under development.

Piper Apache Model G twin (AW Mar. 7, p. 255), which features improved window design and lighter rudder pressures, has entered production. Plane also has improved carburetor heat system and increased gear and flap extension speeds.

Genaire Co. of Hamilton, Ont., Can., has become service and parts distributor for Mooney Aircraft, Inc., airplanes in eastern Canada. Charles Colley is chief air engineer, and Ted Delaney is Hamilton branch manager.

Four-engine Lockheed JetStar executive transport has been purchased by SNAM S.p.A., a wholly-owned subsidiary of Italy's state-owned petroleum company, Ente Nazionale Idrocarburi. Firm will use the pressurized plane for flights over Europe, Asia, Africa and South America. Delivery will be made in mid-1961.

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ignored weather warnings that his destination would go below VFR minimums after sunset. Cause was listed as: non-instrument pilot lost control while attempting a night flight in instrument conditions.

A Cessna 190 was climbing through a break in the overcast near Lone Pine, Calif., and when it closed in, the pilot attempted to continue the climb on instruments. However, he suddenly found that he had not maintained his heading and tried to turn back. The aircraft collided with trees on a mountainside and disintegrated. Probable cause listed by the Board was that the pilot, not qualified for instrument flight, continued flying in instrument weather.

Instrument Instruction

Near Graymount, Ill., the pilot of a Cessna 190, carrying five passengers, continued a flight in instrument conditions although he was not instrument qualified. The wings of the aircraft were torn off in flight and the fuselage was seen to dive from the low overcast and crash in a farm field. A short time before the pilot took off on the outgoing portion of this trip, he was given some instruction in instrument flight (under the hood) and had been unable to maintain control in level flight or to hold a heading. Probable cause listed was that the pilot, unqualified for instrument flight, attempted to continue flight under instrument conditions.

PRIVATE LINES

University of California's Institute of Transportation and Traffic Engineering is conducting a study of private aviation in California, to develop an inventory of airports, a count of privately-owned aircraft by types, and data on the "where" and extent of flying, according to trip purpose—pleasure, instructional, commercial, or business. Study cost is being shared by State Senate Committee on Transportation and Public Utilities.

Piper Aircraft Corp. has entered the avionics field with purchase of Aero Signal Laboratories, Phoenix, Ariz. The acquisition is being moved to Piper's Research and Development Center at Vero Beach, Fla., where its principal product, a low-frequency radio direction finder called the Autonav, will be manufactured as an optional equipment item on all single-engine Piper aircraft.

All-metal single-place sailplane, the A-15, has been developed by Soviet aircraft designer O. K. Antonov, who claims that it has a maximum speed of 155 mph. Gross weight is approxi-

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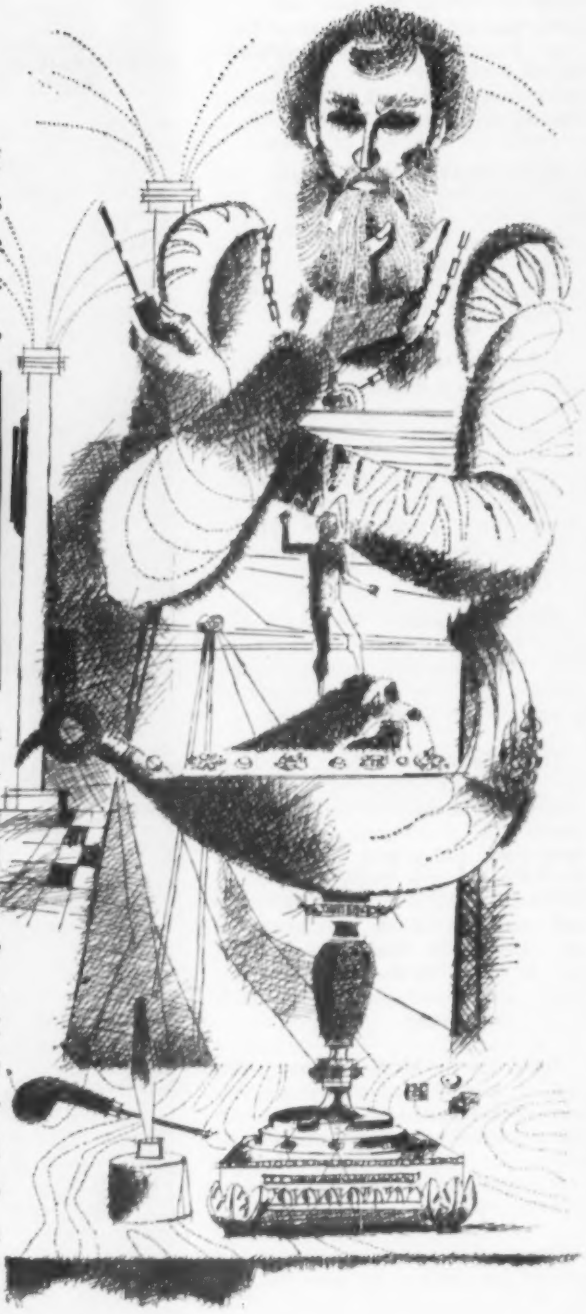

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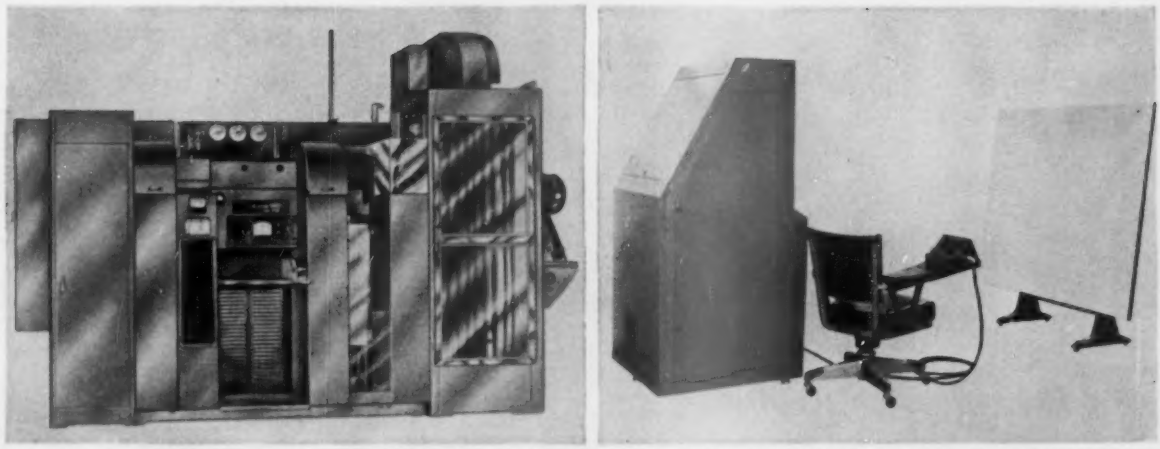


PHOTOGRAPHIC processing system components include variable spray processor, left, capable of handling film lengths of 1,800 ft. Group projection viewer, right, permits study of a 24X magnified image by several photo interpreters.

USAF Studies Satellite Film Processor

Automatic film processing to handle the vast quantities of film produced by photo reconnaissance satellites is being evaluated by the Air Force. The ground handling system will automatically process, index, reproduce and display 70 mm. high resolution panoramic aerial photographs.

The aerial reconnaissance ground handling system, developed by Itek Corp., Waltham, Mass., is being tested at the Air Force Aeronautical Chart and Information Center, Vint Hills, Va. The prototype system produces duplicates for viewing or plotting from raw film in about two hours.

Rapid Processor

The Itek film processor is not intended to provide rapid processing of small amounts of film. Tactical aerial photographs can be interpreted while wet soon after removal from the aircraft (AW June 20, p. 149). A rapid processor developed by Chicago Aerial Industries may permit automatic airborne processing for immediate interpretation upon removal from photo planes.

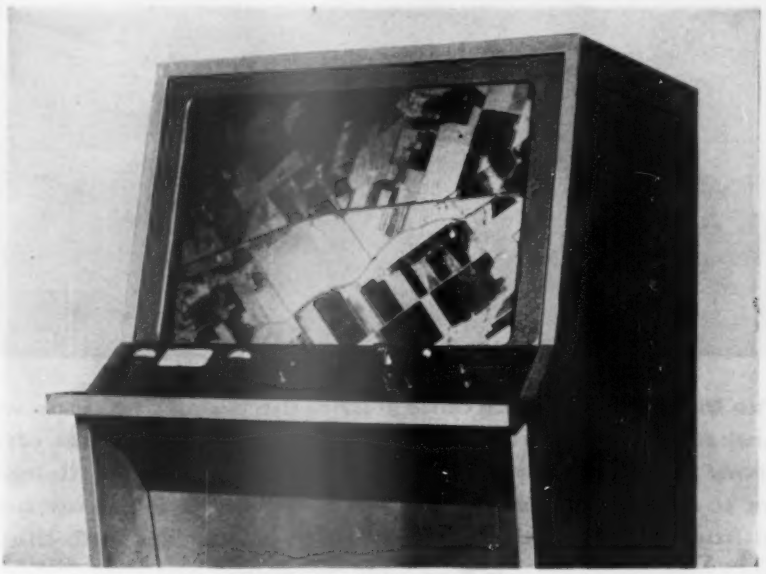
The automatic ground handling systems are needed to provide the capacity to process and index the large quantities of film generated by an aerial reconnaissance satellite or an "open skies" aerial inspection plan. Without a rapid processing capability for the large quantities of film produced, such satellites and plans would be of little value.

The prototype system operating at Vint Hills includes a variable spray processor, a film titler, contact duplicator, rectifier printer, individual mensuration viewer (for measurements), projection viewer, static enlarger and scanning enlarger.

The processor, a variable speed type, handles high resolution photography of 100 lines per mm. Film speed drive can be varied from 0 to 30 fpm. The processor will accept up to 2,500 ft. of film in a single loading and new film may be spliced in without interrupting the processing. Film must be loaded in dark or subdued light.

The film titler, which provides legible markings at speeds to 1,800 fph., employs a gold foil system to imprint an identifying code on the original negative. The system's contact duplicator is designed to accommodate continuous lengths of positive and negative materials up to 1,800 ft. long, print at speeds from 10 to 75 fpm., and maintain resolutions exceeding 180 lines per mm. through three generations.

The rectifying printer transforms original panoramic frames photographically into a plane projection. This permits accurate plotting on the photo-



INDIVIDUAL mensuration viewer is linked with a two-coordinate analog computer to compute actual ground distances on the basis of projected image measurements.

The Big Look. The Fairchild F-27 is the propjet with the wide, wide view and the look and feel of comfort. Large panoramic windows that offer every passenger an "up front" seat. Air conditioning that functions as efficiently on sun-baked runways as it does high in the air. Pressurization that never varies no matter the altitude. This is the Fairchild F-27, propjet with the Big Look.

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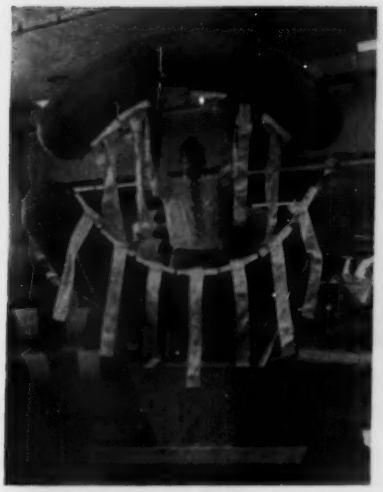

Polaris Cushion

Rubberized fabric air springs cushion Lockheed Polaris submarine missiles during transportation and storage. The inflatable cushions are produced by the Air Cruisers Division of the Garrett Corp., Belmar, N. J.

graph by eliminating the intrinsic distortion of cylinder projection.

An individual mensuration viewer within the system permits viewing any portion of a contact transparency at adequate magnification. Operating on the rear-projection principle, the photo image is projected through a special field lens which compensates for the field curvature of the panoramic photo into a flat field. A two-coordinate analog computer is linked with the viewer system to compute actual ground distances on the basis of the projected image measurements.

A group projection viewer, operated by a remote control, permits several photo interpreters to study a 24X magnified film image. A 10X static enlarger is included in the system to provide enlargements of selected 2¼ x 2¼ in. sections of the 70mm. negatives. An 8X scanning enlarger produces 18-ft. long documentary display prints.

The ground handling system with necessary working space for operators and interpreters can be housed in a room measuring 20 x 40 ft.

USAF says that it will develop a successor to the prototype system which will be capable of greater capacity and more automation in its operation. The advanced version also will be designed by Itek.

Other optical research conducted by the Massachusetts company includes the effects of physical phenomena on optical systems, the basic photophysics and photochemistry of photo-sensitive receptors and high-speed scope readout methods.

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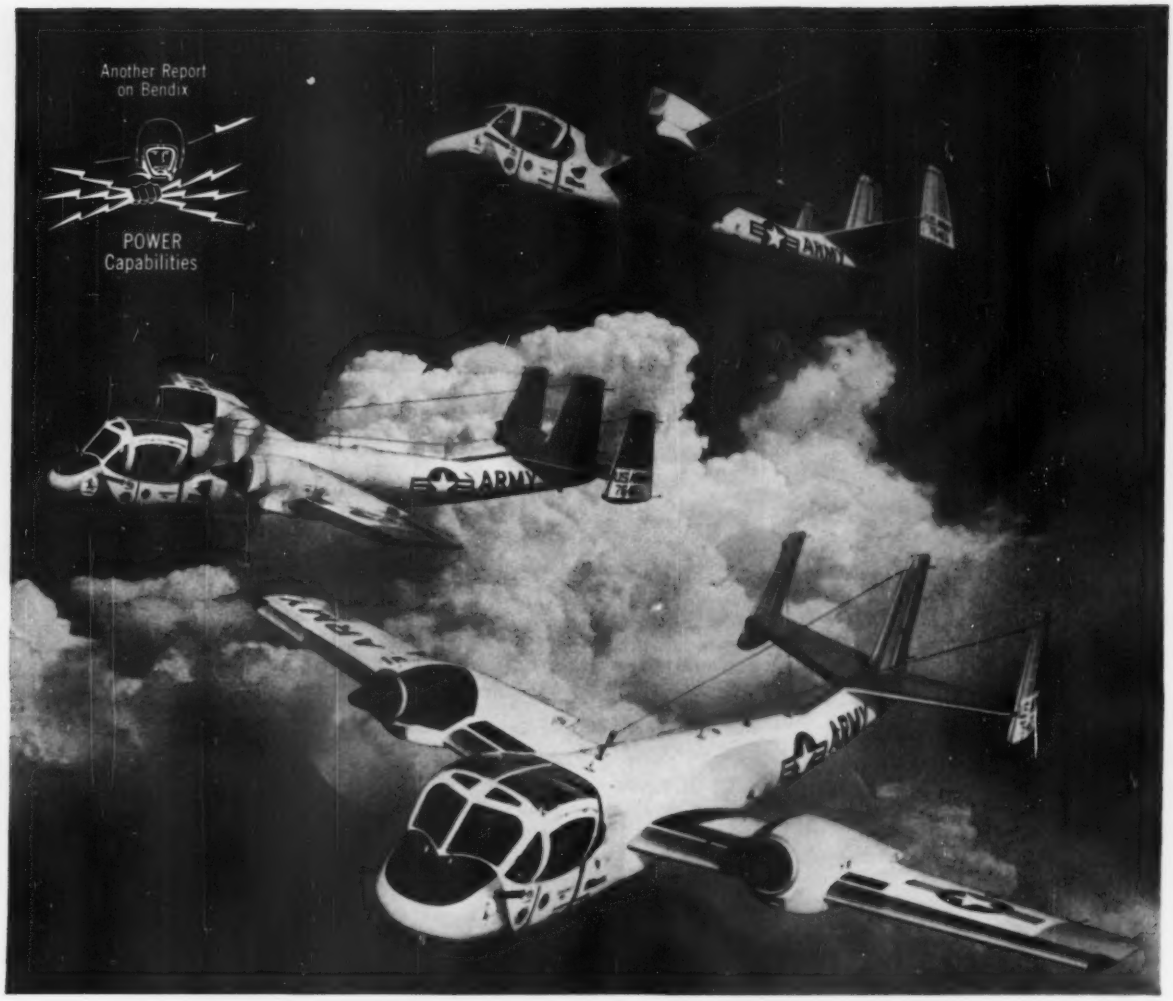
Robertshaw MR. CONTROLS



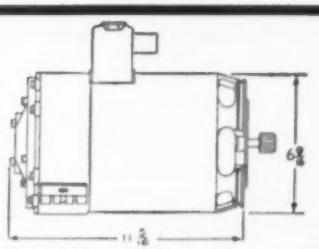
BENDIX STARTER-GENERATOR PROVIDES "KICK" AND POWER FOR U. S. ARMY'S NEW "MOHAWK"

One of the largest aircraft ever to enter Army service, the Grumman AO-1 "Mohawk" has all-weather, day or night observation capabilities.

The "Mohawk's" electrical system includes two Bendix starter-generators and regulators. During engine starting, the units operate as high torque electric motors, with power supplied externally. As the engine ignites, the units automatically shift from starter to generator function.

These Bendix starter-generators are rated at 30V., 400 amps, with a speed range of 4,000-8,000 RPM, and meet MIL-G-6162. They are available with a variety of air spouts and have accommodations for QAD mounting.

This versatile package, combining starting and power generating functions, is another example of Bendix ability in delivering power requirements. Get further details from RED BANK GENERAL PRODUCTS DEPARTMENT.



Bendix Red Bank 30837 starter-generator supplies 65 lb. ft. of starting torque at 1400 RPM. It is dependable, compact, and weighs only 53 lbs.

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Current Tester Cuts Maintenance Costs

By Richard Sweeney

Los Angeles—Nondestructive test system for airplane structures and parts, designed around electrical eddy current theory, is cutting manhour and materiel maintenance costs for United Air Lines and other air carriers.

The equipment was designed by Magnaflux Corp., and development was a joint effort by Magnaflux and United, with the air carrier devising a number of applications for the system which include:

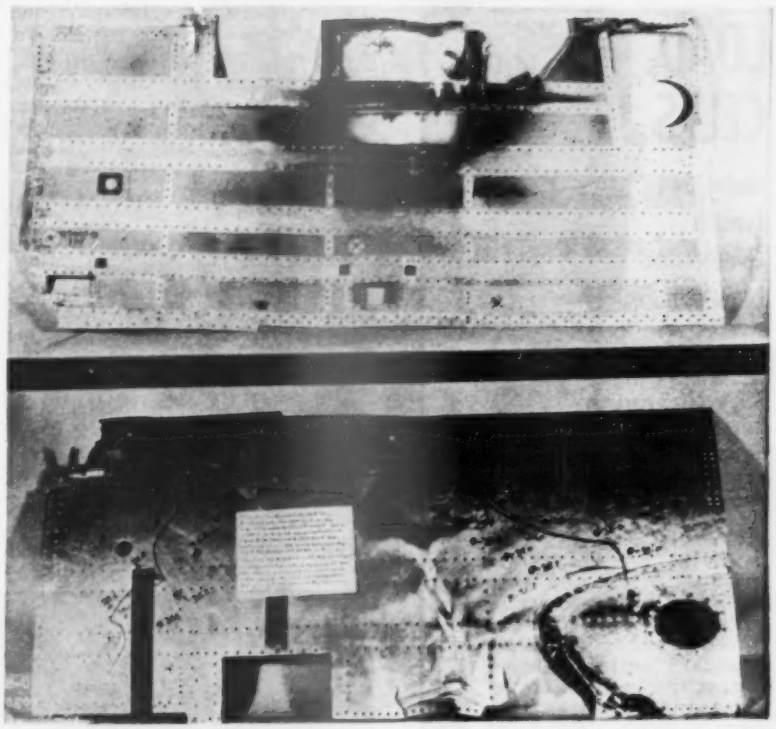
- **Testing for structural** soundness in hard-to-see locations in aircraft.
- **Testing parts** and components for hidden defects.
- **Testing parts** and materiel for incipient failures.
- **Sorting parts** and materiel which may look alike yet be of different material or the same material with different properties such as hardness.

Eddy Current

Eddy current is the phenomena whereby when a coil is applied to a piece of conductive material, a current flow in the material is set up but in a direction opposite to that of the coil, i.e. a right-hand-wound coil would induce a left hand turning eddy current. The eddy current is significantly affected by the properties and condition of the material, such as cracks, soft spots, crystallization. The eddy current circuit makes use of a bridge, with a readout dial included in the circuit, and the readout values indicate the changes from normal in properties affecting conductivity of the piece being tested.

In its application development, United Air Lines put a Magnaflux eddy current test unit to work at its San Francisco maintenance base some time ago, specifically designed for and aimed at one job—inspecting for and detecting cracks emanating from the spark plug bosses of R-2800 engine cylinders. In addition to detecting crack existence, the unit was designed to measure their depth accurately. Installed on the powerplant overhaul production line, the tester was unavailable for development of new applications.

Basically, the tester consists of the indicating and circuit creating unit, plus a probe containing the coil. Probe configuration changes according to the type of work to be done—detect cracks, sort materials. When the probe is applied to a test piece which contains some kind of fault, the impedance created by the fault shows up in microamperes on the readout dial in the anti-resonant bridge circuit.



SKIN from a Northrop F-89 which was damaged by internal fire, is .051 in. thick 7075 T-6 Alclad aluminum alloy. Bottom photo shows outline which eddy current testing showed to be annealed as a result of the fire, and needed replacement. Top half of picture shows the blackened area which proved to be annealed after the part was removed.

For United's first work, the probe was designed for the plug boss testing. When the airline added additional units, several probe configurations were also adopted, which were shaped according to the type of work and test piece, such as airplane wheels, jet engine turbine wheels, aircraft wing spar caps and shear webs.

Eddy Tester

United was able to use the eddy tester, called ED-500 by Magnaflux, to measure crack depth accurately to the extent that rework feasibility was automatically determined as well, a feat which was impossible using dye penetrant inspection techniques. The saving in direct inspection time was from 29 to 30 manhours (from 32 to 2 or 3), while materiel saving was effected through longer use of cylinders before cracks reached rework proportions. Additional saving was accrued through not having to re-do cylinders where the crack depth exceeded re-work limits.

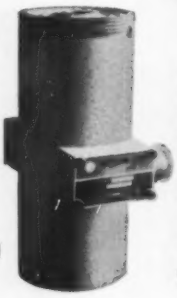
Development of additional probe configurations enabled United to extend its eddy testing to airplane wheels, where cracks frequently were sealed by dirt, oil, grease and rubber from the tire. Cleaning wheels was not completely satisfactory, especially when crack filling was sealed in by heat and pressure such as a hot-hard landing. Filling in cracks did not affect eddy testing in the same way; cracks were detected and depth assessed.

While developing the eddy current

EDDY current tester is used to detect flaws and cracks in metal areas where rivet holes have been bored. Previously, such metal parts had to be removed for inspection.

Another of a series of files on precision products by ALINCO

LOAD CELLS



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For additional information on the Model 344 Load Cells or for the answer to a specific load cell requirement, write:

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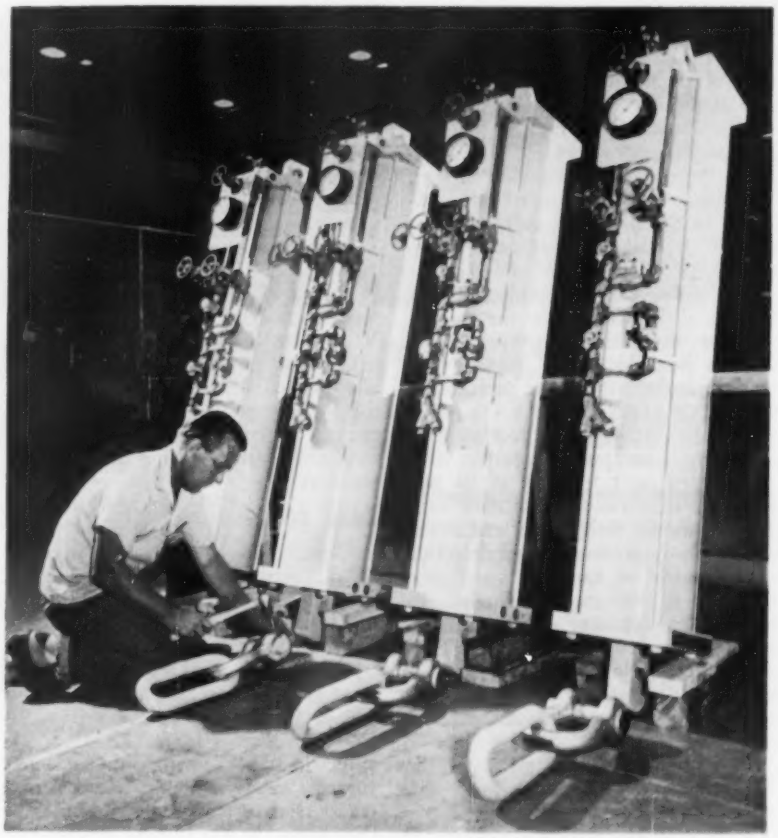
test techniques, United found some difficult problems, a primary one being that different inspectors handled the probe differently, thus readings were different for the same test piece and probe when several inspectors did the work. One design feature of the Magnaflux equipment is a "liftoff" feature, which enables the unit to test rough surface pieces, or conducting material pieces over which coatings have been applied like paint or sealant.

Test Criteria

The airline finally established basic probe-handling techniques and criteria, then assembly of statistics to determine standard readings for the flawless specimens of each piece on which the test was used began. Over a period of time, the airline has been able to determine that when testing the left inboard main landing gear wheel of a Convair, a flawless piece produces a certain reading, while a crack of certain dimensions is acceptable according to the reading, although a crack which looks the same but produces a different reading is unacceptable and the wheel needs replacement, junking or rework.

Extending the applications, eddy current's predictable reactions have enabled the tester to act as a material sorter, such as separating a batch of ⅞-in. dia. head bolts of the same length where some may be titanium, some carbon steel and others chrome moly steel. Similar advantages can be taken of the various conductivity of sheet metal of various alloys. A variation on this is using the eddy current tester to detect such flaws as soft spots in steel pieces, or porous spots in castings, or worn or fatigue-ridden spots in various parts and components where the material's basic crystalline structure has been altered by stress to a degree where conductivity is changed.

Among airlines now using eddy current testers, according to Magnaflux, are United, Trans World Airlines, Northeast Airlines and Northwest Orient Airlines, and Pacific Airmotive Corp. which uses the unit in its jet engine overhaul facility.



Boeing Delivers Atlas Silo Cylinders

Atlas silo air spring support cylinders, used to keep the silo floor level at all times and to provide a spring cushion for the intercontinental ballistic missile, are being delivered by Boeing Airplane Co.'s Wichita Division. Large links in front of the cylinders are part of devices which connect them to the silo flooring. Corps of Engineers contracts, worth $2 million, call for production of 75 support cylinders.

DESIGN ALDCROFT

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Baggage Inspection X-Ray

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The inspection unit permits direct viewing, closed circuit television viewing or will make a permanent record on 70 mm. or 16 mm. film. The equipment is 52 in. high, 62 in. long and 32 in. wide.

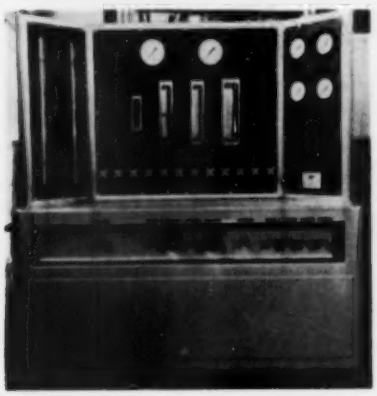
The unit cost is $6,500 in lots of six or more. Leasing arrangements are available.

Daly Industrial X-Ray, Inc., 702 Pershing Sq. Building, Los Angeles, Calif.

Oxygen Test Stand

Stand is designed to test aircraft oxygen system components. The unit was designed specifically for the emergency systems on jet transport aircraft.

Model A211 oxygen test stand consists of an oxygen cylinder supply, and gages, regulators, valves, flowmeters and



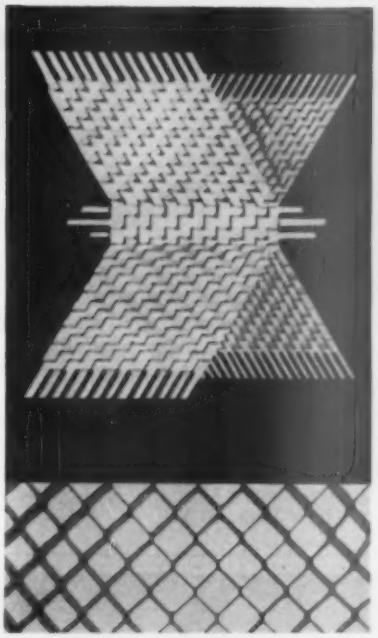
manometers to check component performance. Four oxygen cylinders supply two pressure regulators which control discharge pressure to 12 outlet valves. The two regulated pressure ranges are 0 – 500 psi. and 0 – 2,100 psi.

Trio-Tech Co., 3098 N. Avon St., Burbank, Calif.

Honeycomb Core

High temperature structural honeycomb core is intended for sandwich construction in spacecraft capsules and heat shields.

Honeycomb, designated HITCOMB, utilizes woven-node square cells demonstrating nearly isotropic shear properties,



the maker states. The woven construction is said to exceed the temperature limitations of bonded-node core and exceeds the specifications of MIL-C-8073A. Both glass fiber and refrasil forms are being combined with such resin systems as phenolics, phenylsilane, silicones, polyesters and epoxies.

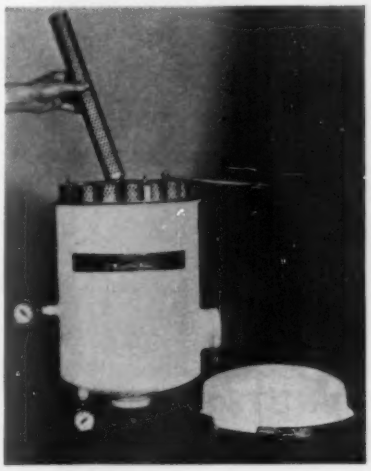
H. I. Thompson Fiber Glass Co., Los Angeles, Calif.

Flight Test Camera

Camera, mounted in the nose of an aircraft, evaluates takeoff and landing characteristics of test aircraft. A reduction of 67% of test time over photographic tracking is claimed with the use of the camera.

The camera takes three photos simultaneously, one straight down and one to either side. The images are recorded on one film. Time reference is furnished by a timed strobe light on the film margin. Working with known runway dimensions, engineers compute velocity, acceleration, attitude, and roll, pitch and yaw angles from the film record. The 16 mm. camera is sold for $7,500.

Lockheed Aircraft Corp., Burbank, Calif.



Fueling Gage

Gage monitors solid contaminants and undissolved water in aviation fuel and automatically shuts off fuel flow at an "unclean" point.

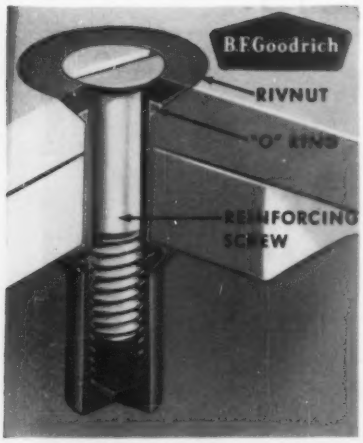
Fuel is monitored by means of fuse-type cartridge assemblies contained in an aluminum alloy casing–the number and length of the fuses determines the rating of the gage. Preloaded and maintained under compression, the fuses are closed at one end and opened to a pressure gage at the other. Contamination is sensed by increasing resistance to fuel flow. The gage which monitors fuel from the water separator is available in 100, 200, 300, 400, 500 and 600-gpm. units.

Bendix Filter Division, Madison Heights, Mich.

Missile Helium Regulator

Two-stage helium regulator is designed to control missile fuel tank pressures. The design is said to minimize the effect of large flow ranges and variations in temperature and inlet pressure.

The regulator, No. 434101, employs static seals, poppet seals and synthetic diaphragms to handle most gases and fluids. Seals are Teflon-coated to assure zero leakage at no-flow, lockup



RIVNUTS® provide fuel-tight fastening

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B.F.Goodrich
Rivnuts
Dept. AW-7C, Akron, Ohio

conditions. Regulator poppets meter between metal edges to resist erosion and the synthetic diaphragms are protected from over-pressure by an interstage relief valve. A variety of gases and fluids may be accommodated by changing the diaphragm composition.

Dyna-Matics Corp., 11679 Sheldon St., Sun Valley, Calif.

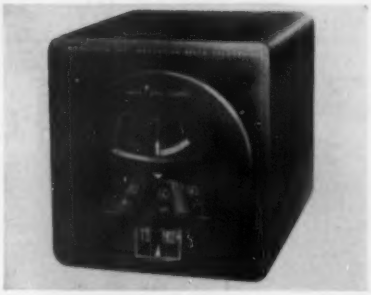
Missile Battery

Two-section missile battery, curved for optimum space utilization, is designed as a power source for missile guidance and flight control systems.

The battery, Model P-3000, is a

primary unit designed for wide variations in discharge rates (up to 100 amp. continuously). Sections "A" and "B" each consist of 20 cells of 3 amp.-hr. nominal capacity. The 22 lb. battery is 5 in. wide, 6 in. high and 15 in. long.

Yardney Electric Corp., 40-50 Leonard St., New York, N. Y.



VOR Indicator

Transistorized VOR indicator with a guaranteed accuracy of 2 deg. operates with any standard VHF receiver.

The Nova/Star omni indicator weighs 12 oz. and fits the standard instrument hole. The navigation instrument is offered as a second omni for instrument flight or as a primary omni for aircraft fitted with a VHF radio. Price is $385.

Nova-Tech, Inc., 1721 Sepulveda Blvd., Manhattan Beach, Calif.

Liquid Propellant Cartridge

Liquid propellant gas cartridge develops high pneumatic pressures to operate pneumatic power-actuated devices. Applications include emergency actuation of landing gear.

The liquid monopropellant affords

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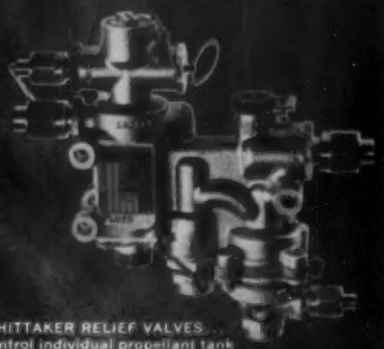
is important in the Discoverer Satellite Program



WHITTAKER RELIEF VALVES control individual propellant tank pressures, differential tank pressures and provides tank dump feature.

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Olin Mathieson Chemical Corp., 460 Park Ave., New York 22, N. Y.

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Reports Available

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Emergency Escape Capsule Studies—Phase 1. Preliminary Laboratory Flotation Studies—by A. P. Kearney and others, Aero Medical Laboratory, Wright Air Development Division, USAF. June, 1959. $.75; 21 pp. (PB 161042)

Development of an Emergency Pressure Suit—C. C. Lutz, Aero Medical Laboratory, Wright Air Development Division, U. S. Air Force. July, 1959. $.75; 25 pp. (PB 161033)

Aerodynamic Phenomena in Stellar Atmospheres—A Bibliography—Boulder Laboratories, National Bureau of Standards, September, 1959. $1.25; 95 pp. (PB 151389)

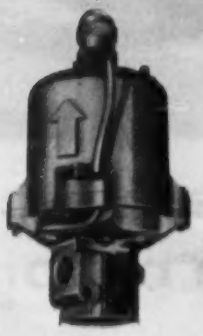
Bibliography on Gas Lubricated Bearings Revised—by E. B. Sciulli, the Franklin Institute, September, 1959. $2.50; 107 pp. (PB 161017)

Tensile Properties of Aircraft—Structural Metals at Various Rates of Loading After Rapid Heating, Part II.—by J. R. Kattus, Southern Research Institute for Wright Air Development Division, U. S. Air Force. May, 1959. $3.00; 187 pp. (PB 151895)

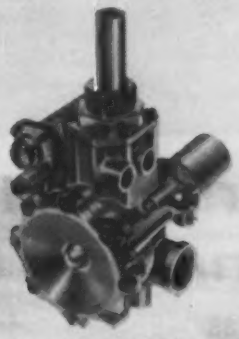
Flight Test Insulation Studies—by A. G. Norem, Curtiss-Wright Corp., for Wright Air Development Center, USAF. February, 1959. $2.00; 71 pp. (PB 161079)

Present Status of and Future Outlook for All-Metal Sandwich Construction for Air Vehicles—by W. A. Tweedie and others, Stanford Research Institute for Bureau of Aeronautics, U. S. Navy. August, 1959. $2.75; 144 pp. (PB 161099)

Notes on Dynamics of Linear Elastic Structures—by G. J. O'Hara, U. S. Naval Research Laboratory. October, 1959. $.50; 19 pp. (PB 151933)



WHITTAKER REGULATOR . . . Controls pressure on propellant tanks for expulsion of fuel and oxidizer to engines.



WHITTAKER PRESSURE REGULATOR . . . programmed for future missile use, is gold plated for balance of solar radiation . . . regulates gas pressure to nozzle valves in vernier control system.

• *Write for your copy of the Whittaker Controls engineering, testing and production Capabilities Brochure.*

WHITTAKER CONTROLS

Division of

915 North Citrus Avenue
Los Angeles 38, California
Phone: HOllywood 4-0181

WC

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"Time-Proven Reliability in Fuel, Pneumatic and Hydraulic Fluid Controls and Systems!"

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DAYTON:	Talbott Bldg., Suite 313, 131 North Ludlow Street, Dayton 2, Ohio • Phone: BAldwin 2-5595
NEW YORK:	600 Old Country Road, Suite 327, Garden City, L. I., New York • Phone: Pioneer 1-4550
SEATTLE:	3308 White Bldg., Seattle 1, Washington • Phone: MAin 3-6150
WICHITA:	6427 East Kellogg Street, Wichita 1, Kansas • Phone: MUrray 2-0332

WC — **WHITTAKER CONTROLS:** Designs and produces fluid control systems, subsystems and components for military and commercial aircraft and missiles.

NI — **NARMCO INDUSTRIES:** Specializing in research and manufacturing in the field of lightweight, high-strength structural components and materials for a variety of Military and Industrial applications.

WG — **WHITTAKER GYRO:** Leading designer and manufacturer of precision gyroscopes, accelerometers, guidance and control systems.

MA — **MONROVIA AVIATION:** Producers of precision aircraft structural assemblies and portable air conditioning units for ground support.

TSI — **TELECOMPUTING SERVICES, INC.:** Specialists in data processing and data systems engineering.

ES — **ELECTRONIC SYSTEMS:** Specialists in systems management, and in the design and manufacture of complex electronic and nucleonic equipment for Government and industry.

DI — **DATA INSTRUMENTS:** Leading designer and producer of data reduction systems, industrial control and ground support equipment.

CB — **COOK BATTERIES:** Designers and manufacturers of automatically and manually activated silver zinc batteries for missile applications.

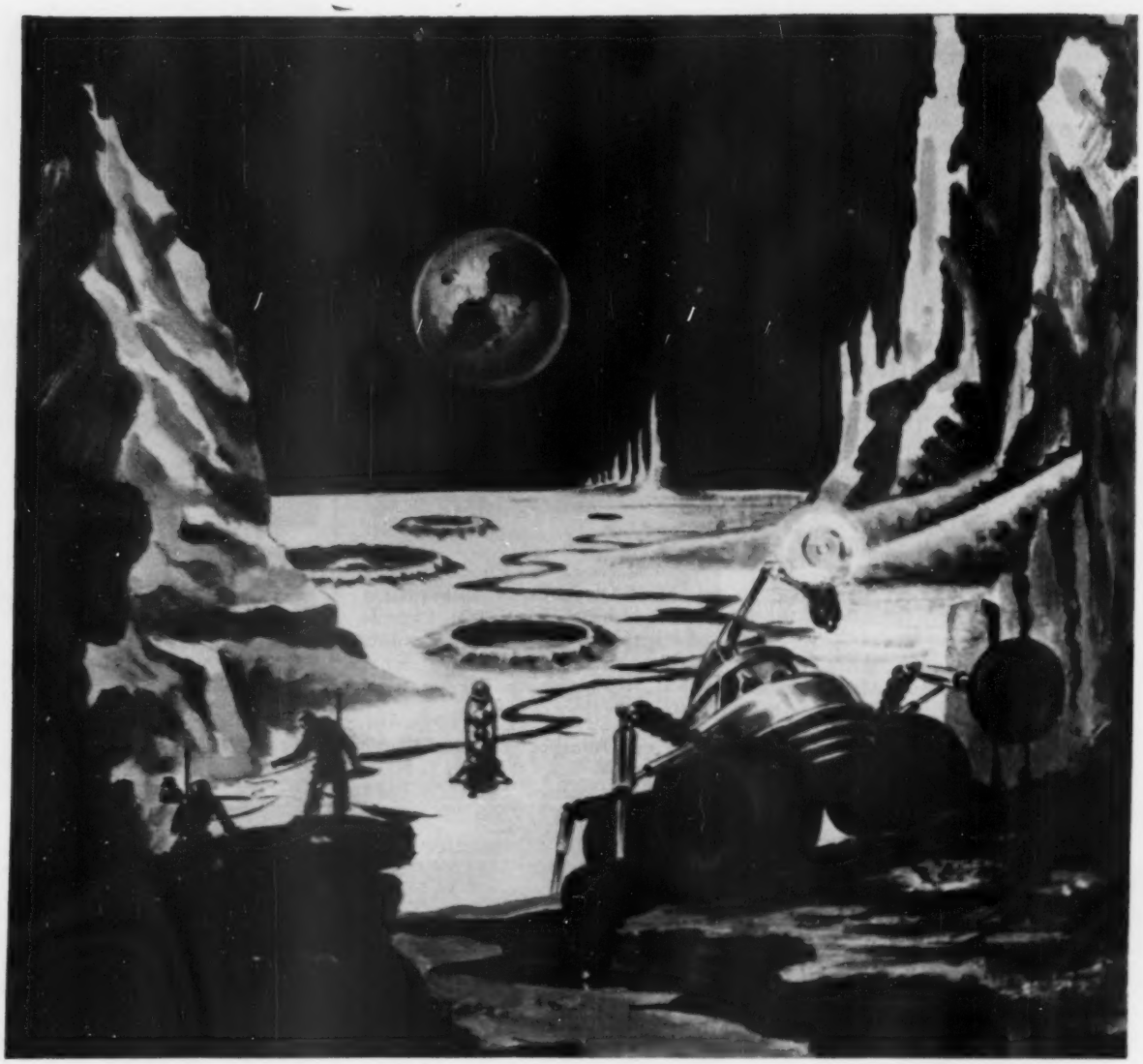
EC — **ELECTRONIC COMPONENTS:** Designers and producers of microminiature relays, sub-miniature ceramic capacitors, magnetic amplifiers, transformers and delay lines.

PE — **PHOENIX ENGINEERING:** Manufacturer and assembler of precision machined missile, aircraft and electronic parts.

TELECOMPUTING CORPORATION

Los Angeles, California

Telecomputing Corporation is a unique combination of carefully integrated organizations. It is staffed with scientific talent of rare ability, designed for the purpose of managing entire Space Technology and Weapon System Projects. Telecomputing is developing *advanced concepts* in industrial and military control systems.



Morse...frontiersmen in kinematics which works on earth or the moon!

Ready to help in the world of new ideas

Are your ideas bogged down by "do-it-yourself" development obstacles?

From the "think" stage through the full manufacturing responsibility, Morse engineers have earned their chevrons in the automotive and aeronautical fields for over 60 years. Their ideas can be most helpful in giving your ideas their needed boost.

Identified in the science of kinematics, Morse capabilities are widespread, but best known in the production of basic chain drives, gear reducers, couplings and clutches... single components or complete power drives.

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Put the Morse powerhouse of supporting facilities backed by Borg-Warner's ultra-modern Roy C. Ingersoll Research Center on your team. The best way to start is by calling: Morse Chain Company, (Dept. 37-70), a Borg-Warner Industry, Ithaca, N.Y. In Canada: Morse Chain of Canada, Ltd., Simcoe, Ontario.

World's largest manufacturer of precision parts

MORSE B-W

A BORG-WARNER INDUSTRY

PROPOSED airborne missile range station version of the Boeing C-135 would require addition of long dorsal blister to accommodate telemetry antennas and optical instrumentation outside the normal loft line of the fuselage. Also added is a longer radome.

Boeing Offers Multi-Mission C-135

By Russell Hawkes

Renton, Wash.—Proposed Boeing C-135 jet-powered military air carrier is being offered to USAF for a variety of jobs. These include:

- **Airborne early warning and control.**
- **Airborne missile range station.**
- **Photo-mapping and surveying.**
- **Electronic warfare officer trainer.**

The C-135 is not to be confused with the proposed swing-tail cargo carrier which is equivalent in size, weight and performance with the Boeing 707-420 intercontinental airplane. The C-135 is not being offered with a swing-tail and is approximately equivalent to the 707-120.

Like the 707-120, it will be powered by four Pratt & Whitney J57 engines in most configurations. The airborne early warning and control version probably will have TF-33 turbofan versions of the J57.

The basic C-135 can be delivered in quantity 15 months after authorization. Testbed airframes could probably be available in less than six months. Production rate of a combined C-135 and KC-135 line can be increased to 20 per month from the present six per month, if necessary.

The basic transport version is being designed for a maximum payload of 83,000 lb. and a main cabin volume of 5,765 cu. ft. The main deck cargo door at the forward end of the cabin measures 9 ft. 9 in. x 6 ft. 6 in.

Basic C-135 Specifications

Weight	
Maximum takeoff gross weight	297,000 lb.
Maximum landing weight	185,000 lb.
Operating weight empty	97,900 lb.
Maximum fuel weight	202,800 lb. (31,200 gal.)
Powerplant	
Engine	P&W J57
Sea level thrust—wet	13,750 lb.
Sea level thrust—dry	11,200 lb.
Capacity	
Maximum payload	83,000 lb.
Main cabin volume	5,765 cu. ft.
Main cabin length	83 ft. 4 in.
Main cabin height	7 ft.
Main cabin width	10 ft. 9 in.
Cargo door	6 ft. 6 in. x 9 ft. 9 in.

If the airplane is to be used as a platform for large electronic systems, the big cargo door would make it possible to load and unload large consoles and equipment racks without disassembling them.

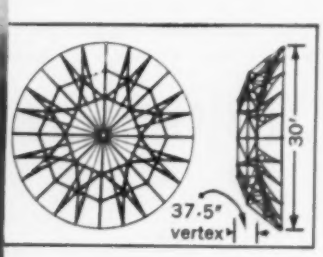
The equipment would be located in the pressurized cabin area and most of the structural cutouts for antennas and other external equipment could be made in the skin of the unpressurized lower fuselage section to minimize weight and cost.

Multiple Load Path

The multiple load path structure of current jet transports simplifies the job of designing structural cutouts because it is easier to avoid seriously weakening the fuselage. Openings up to 18 in. in diameter can be made in the skin without cutting a circular frame. Longitudinal stiffeners are continuous between frames and skin, so splices can be made at any point. If additional equipment space is needed, some of the fuel tankage in the lower unpressurized section could be sacrificed to make room for it.

Boeing reports the range of the

This precision 30-foot antenna has a more accurate surface than any other production parabolic reflector of comparable size.



Antenna System's new solid surface, high precision 30-foot antenna (model 103) is designed to set a new standard for accuracy in the fields of radio astronomy, tropospheric scatter propagation, tracking radar, and experimental test installations. It features:

• High precision — The static surface tolerance of the first unit has been measured. The deviation from the ideal curve measured 0.033 inches RMS.

• Has an f/d ratio of 0.417 which readily adapts to a wide variety of feed systems.
• Fully machined sections are interchangeable and easy to assemble.
• Solid surface panels permit use at any frequency.
• Useable with a wide variety of feed support systems.
• Built to withstand 150 MPH wind with 4" ice.
• Can be mounted on either the top or side of a tower with azimuth and elevation adjustments, on el-az or equatorial pedestals, self-contained trailer tower mounts, or other types of mounts.

Write for specification sheet.

DESIGNERS AND MANUFACTURERS OF A-S ANTENNA SYSTEMS

ANTENNA SYSTEMS INC. HINGHAM, MASSACHUSETTS

C-135 Special Versions

Airborne Early Warning & Control	
Added system weight	28,000 lb.
Maximum range	6,700 naut. mi.
Maximum altitude	47,000 ft.
Maximum endurance time (TF-33 engines)	16 hr.
Airborne Missile Range Station	
Added system weight	13,600 lb.
Maximum range	6,700 naut. mi.
Maximum altitude	50,000 ft.
Maximum endurance time (J57-P59W engines)	16 hr.
Electronic Warfare Officer Trainer	
Added system weight (including 231 antennas)	46,300 lb.
Maximum range	4,500 naut. mi.
Maximum altitude (J57-P59W engines)	44,000 ft.
Air Photo-Mapping and Surveying	
Added system weight	5,000 lb.
Maximum range	7,700 naut. mi.
Maximum altitude (J57-P59W engines)	50,000 ft.

C-135 as more than 7,500 naut. mi. with a 10,000 lb. payload, or over 3,600 naut. mi. with the 83,000 lb. maximum payload. The wide variation is made possible by the small ratio of operating weight-empty to maximum takeoff gross weight.

For such missions as early warning or missile range telemetry reception, the C-135 can keep station close to its base for up to 19.5 hr. at optimum altitude or 15.6 hr. at sea level. Boeing says the high speed and long range of the C-135 would result in a high ratio of time-on-station to total mission duration.

Sales Pitch

An important point in the Boeing sales pitch for the C-135 is the progress along the learning curve made with the nearly identical KC-135 tanker and the family of Model 707 commercial jets. The company claims that Air Force records show the KC-135 has a 91.9% probability of completing a normal 6 hr. mission without delays or deviations due to mechanical trouble. At the beginning of 1958, the probability was set at 79%.

Boeing projects an average C-135 utilization of 8 hr. per day if eight-hour missions are flown and says 10 hr. per day utilization should be attainable for 13-hr. missions. These estimates are largely based on commercial 707 utilization of 8-11 hr. a day with flights lasting from 5-6.5 hr.

Maintenance will be about the same as that for the KC-135. Its postflight inspection interval has been increased from 25 hr. to 300 hr. in 1958. Boeing says plans are under way to raise the periodic inspection interval to 600 hr.

The jet transport should offer a good

environment for the sensitive avionics used in the proposed missions. Stresses due to vibration, noise, extreme temperatures and pressure variations are much lower than in propeller aircraft being used for comparable jobs. The C-135 air-conditioning system can maintain sea level altitude up to an airplane altitude of 22,000 ft. and a 7,000-ft. cabin altitude at an airplane altitude of 40,000 ft.

Design Payload

The main cabin floor of the C-135 is designed for distributed loads up to 200 psf. Equipment bays and consoles would be fastened to eight pairs of 10,000-lb. tie-down fittings arranged along the sides of the deck or the 5,000-lb. fittings distributed over the floor on a 20-in. grid pattern.

As an airborne missile range station, the C-135 would be given an extended nose radome and a long dorsal blister in which to locate telemetry antennas, tracking cameras, etc. The use of an external blister would seem to offer a wider angle of coverage and minimize the number of holes to be cut in the pressure cabin.

The early warning version drawings show an unusual electrically scanned three-segment antenna which gives 360 deg. coverage. One sector is covered by a long-forward-swept, airfoil-shaped antenna extending upward from the top of the fuselage to provide coverage below the horizontal.

Alouette III Undergoes High Altitude Tests

Alouette III, powered by an Artouste III turbine engine of 700 shp., is shown undergoing tests in the French Alps. Two prototypes of the Alouette III, which first flew in February, 1959, have been ordered for military evaluation.

BASIC BUILDING BLOCKS FROM KEARFOTT

EXPLOSION-PROOF AXIALVANE BLOWER MOTOR

This thermally protected, explosion-proof induction motor drives an Axialvane blower unit used as an air circulator on aircraft air conditioning systems. Unit features high output to weight ratio in an extremely compact package and conforms with the requirements of MIL-M-7969A. Motor has been environmentally tested to conform with MIL-E-5272A per Procedure I, covering humidity, high and low temperature, explosion-proof, altitude and vibration requirements. These Model F-25-2 motors are produced by Kearfott's subsidiary, the *Hertner Electric Company.*

SPECIFICATIONS
Model F-25-2

H.P.	12.4
Volts	200
Phase	3
Cycles	400
RPM	11,600
Duty	Continuous
Dimensions	5½" diam. x 5¾6" long
Weight	17.75 pounds

Write for complete data.

KEARFOTT DIVISION
GENERAL PRECISION, INC.
Little Falls, New Jersey

"WORLD'S CLEANEST" ASSEMBLY ROOM. This 55-station facility is so skillfully designed, air-conditioned, and filtered that 99.95% of all contamination bigger than 1 micron (.000005") is removed. The result: perfect conditions for mass assembly of delicately precise components.

Knowmanship in Action:

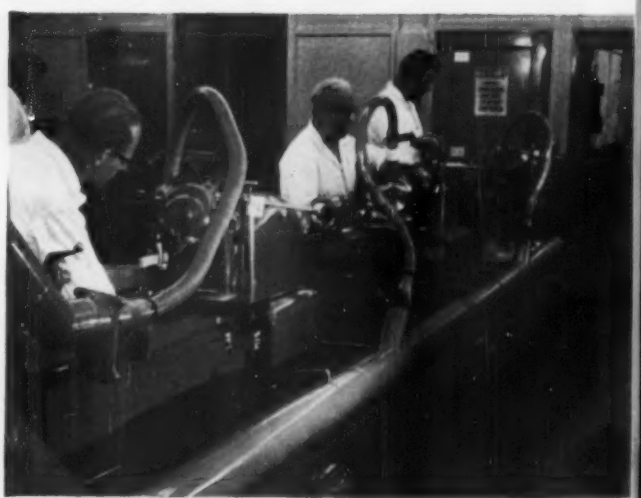
HOW UNIFIED E-P FACILITIES MASS-PRODUCE FOR PRECISION NEEDS OF THE AERO/SPACE AGE

Many of the aero/space age's most precise components are being mass-produced today at Eclipse-Pioneer. An example: inertial guidance systems for second-generation missiles... a true test —and proof—of E-P Knowmanship in action.

Our mass-production complex is completely self-contained and unified. Here, in an atmosphere of ultra-cleanliness, precision components are assembled, tested, checked, calibrated and stored under the exacting demands of superfine quality control.

Far more than a prototype, this aero/space-age facility is a going concern, ready to go to work on *your* problems. Benefit from Eclipse-Pioneer's Knowmanship, developed through 40 years' close association with the aero/space industry. Write today—describe your problems—utilize our capabilities.

TECHNICAL KNOWLEDGE + EXPERIENCED MANAGEMENT
+ SPECIALIZED CRAFTSMANSHIP = **KNOWMANSHIP**



BERYLLIUM—SPACE-AGE METAL. Here, in a completely enclosed, temperature-controlled room, highly skilled E-P machinists work with beryllium. Parts such as gyro components for missiles are produced to tolerances of ± 10 millionths of an inch. For the exacting demands of this kind of production, entirely new concepts in machining, quality controls and safety engineering were developed by Eclipse-Pioneer.

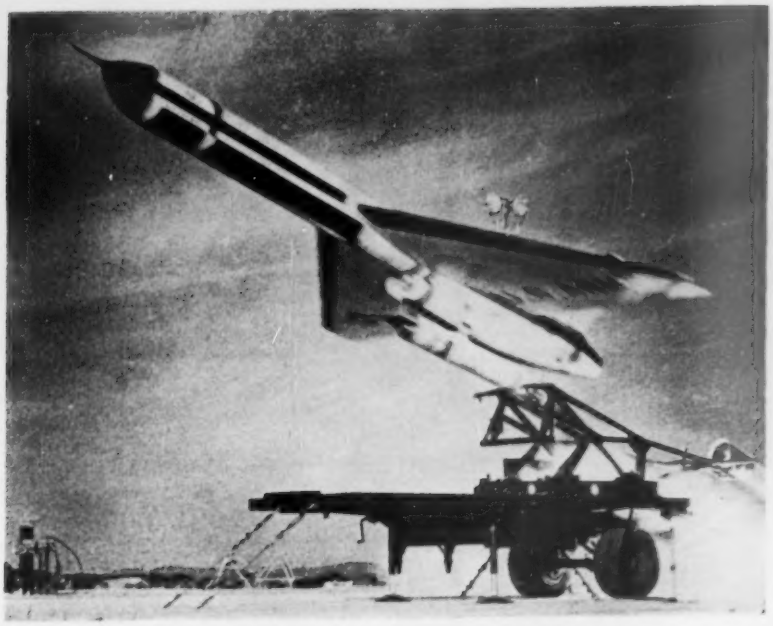
← SUPERFINE TEST AND CALIBRATION. E-P checkout facilities include: Single axis and planetary sidereal test stands accurate to .005° per hour; indexing heads with an accuracy of ± 2 seconds of arc used for calibrating pendulous integrating gyros; turn-tilt stands positionable to ± 5 seconds of arc; and ball disc integrator test stands accurate to .0025%. Calibration equipment was bench-mark-positioned by certified geodetic survey.

THE Bendix CORPORATION

Eclipse-Pioneer Division

TETERBORO, N. J.

AUTOMATIC FLIGHT CONTROLS • CENTRAL AIR DATA SYSTEMS • SPECIALIZED INSTRUMENTATION • NAVIGATION COMPUTERS AND DIRECTORS • STABLE PLATFORMS • INERTIAL GUIDANCE • RADAR ANTENNA STABILIZATION AND TRACKING SYSTEMS • GROUND SUPPORT EQUIPMENT



Army Flies New Jet Surveillance Drone

First photo of U. S. Army SD-5 jet surveillance drone shows launch for successful test flight at Ft. Huachuca, Ariz. Designed for missions of greater speed and longer endurance than previous surveillance drones, the SD-5, built by Fairchild Engine & Airplane Corp., will carry electronic surveillance equipment to provide information on enemy movements.

Electronics Capital Extends Commitments

Electronics Capital Corp. has purchased $250,000 of five-year convertible debentures issued by Remanco, Inc., Santa Monica, Calif., engaged in development and manufacture of microwave test equipment. The debentures are convertible into 59% of Remanco's total common stock.

The purchase is Electronics Capital's ninth investment commitment, bringing total investments to $5,300,000. Last month Electro Radiation, Inc., sold $600,000 of five-year convertible debentures to Electronics Capital. The debentures may be converted into 70% of Electro Radiation common stock.

Electro Radiation is studying molecular electronics, solid state physics, electroluminescence and plasma technology. Other investment commitments by Electronics Capital include:

- **Duncan Electronics, Inc.,** Los Angeles–$800,000.
- **Ultronix, Inc.,** San Mateo, Calif–$300,000.
- **Electronic Energy Conversion Corp.,** New York–$1,250,000.
- **Cain & Co.,** Los Angeles–$400,000.
- **Vega Electronics Corp.,** Cupertino, Calif.–$300,000.
- **General Electrodynamics Corp.,** Garland, Tex.–$400,000.
- **Potter Instrument Co., Inc.,** Plainview, N. Y.–$1,000,000.

Electronics Capital recently arranged the acquisition by Cain & Co. of Memo, Inc., New York, electronics sales engineering company covering the New York, New Jersey and Philadelphia area. Cain & Co. is a national electronics sales engineering firm.

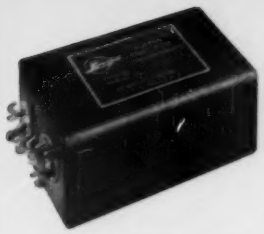
New Offerings

Electro Nuclear Systems Corp., Minneapolis, Minn., incorporated in April, 1960, to engage in research, development and manufacture of advanced systems and equipment for industry and government. Offering was the company's initial financing step with the public sale of 650,000 shares of stock at $1 per share.

Cenco Instruments Corp., Chicago, Ill., a holding company whose subsidiaries are primarily engaged in the manufacture and sale of scientific instruments, laboratory apparatus and supplies for use in education and industry. Offering is $5,000,000 of convertible debentures due August, 1980, for public sale; interest rate, public offering price and underwriting terms to be supplied by amendment. Proceeds will be added to general funds and will be available for any proper corporate purpose, including the payment of some $500,000 of bank indebtedness.

Waterman Products Co., Inc., Philadelphia, Pa., engaged in the design, manufacture and sale of electronic

BASIC BUILDING BLOCKS FROM KEARFOTT



DUAL CHANNEL BUFFER AMPLIFIER

This small, light-weight unit, a completely transistorized dual channel buffer amplifier, is designed to drive Kearfott's size 11 R980 winding compensated synchro resolvers. The amplifier-resolver combination has stable gain characteristics and negligible phase shift through an ambient temperature range of −55°C to +85°C. Kearfott-developed packaging and potting techniques have created an amplifier with extremely high resistance to shock and vibration. This unit meets the environmental requirements of MIL-E-5272.

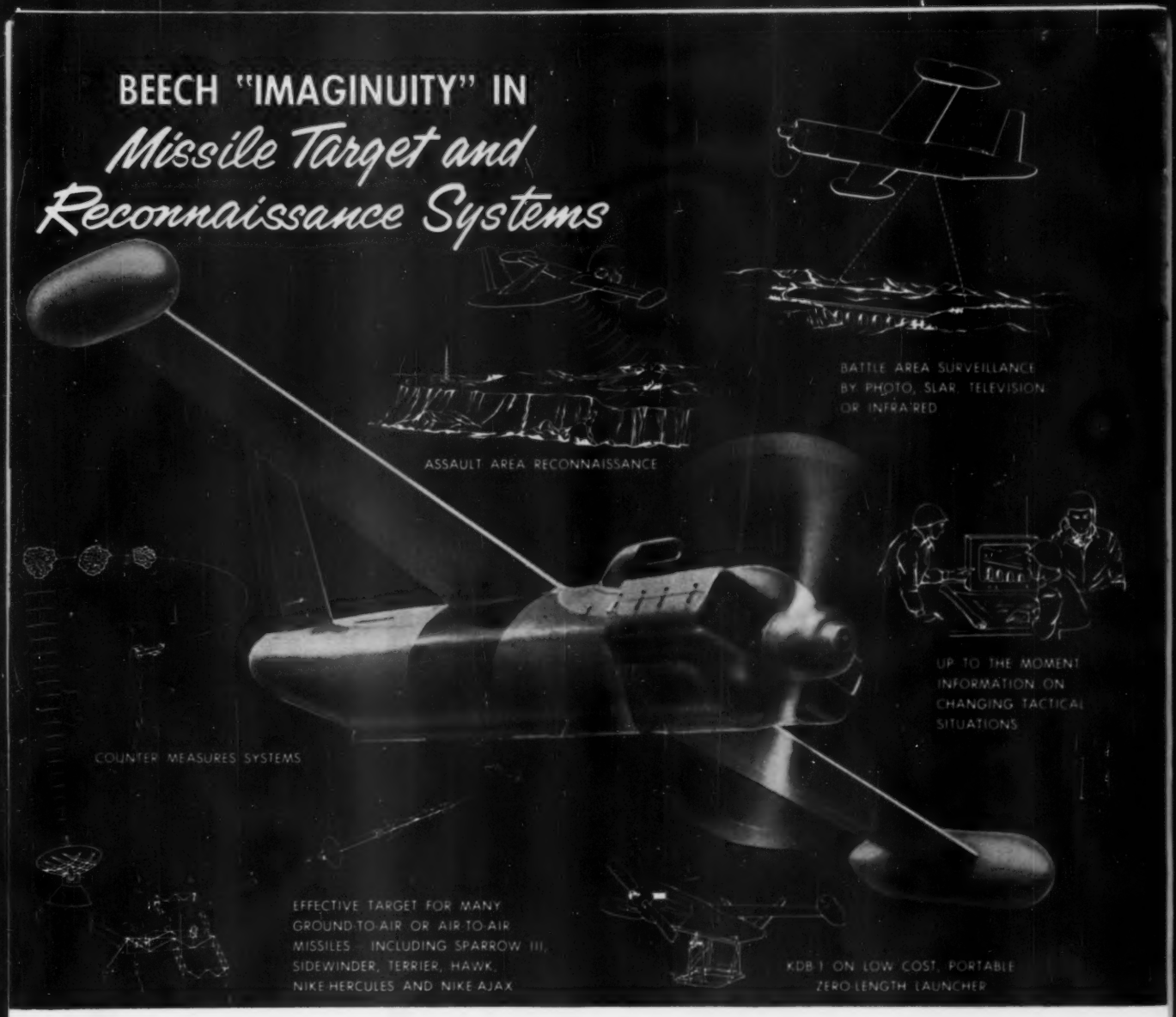
TYPICAL CHARACTERISTICS / S3100

Electrical:
Number of Inputs/4 per channel
Input Impedance (ohms resistive)/100,000
Voltage Gain (Resolver compensating winding output to input)/1 ±0.02
Phase Shift (Rotor output to input)/Less than 15 minutes
Max. Signal Output Voltage/16 volts
Signal Frequency (cps)/400 ±20
Power Input at 10 MA Max./40 VDC ± 1 V
Maximum Input Voltage (Volts RMS)/60
Voltage Transfer Ratio/1 ±.0005

Mechanical:
Ambient Temperature Range (°C)/−55 to +85
Storage Temperature (°C)/−65 to +200
Construction/Hermetically sealed
Weight (Oz.)/5½ (Max.)

Write for complete data.

KEARFOTT DIVISION
GENERAL PRECISION, INC.
Little Falls, New Jersey


BEECH "IMAGINUITY" IN
Missile Target and Reconnaissance Systems
BATTLE AREA SURVEILLANCE BY PHOTO, SLAR, TELEVISION OR INFRA-RED
ASSAULT AREA RECONNAISSANCE
UP TO THE MOMENT INFORMATION ON CHANGING TACTICAL SITUATIONS
COUNTER MEASURES SYSTEMS
EFFECTIVE TARGET FOR MANY GROUND-TO-AIR OR AIR-TO-AIR MISSILES — INCLUDING SPARROW III, SIDEWINDER, TERRIER, HAWK, NIKE-HERCULES AND NIKE-AJAX
KDB-1 ON LOW COST, PORTABLE ZERO-LENGTH LAUNCHER

Beech Army/Navy KDB-1: Versatility at low cost . . .

Radio-controlled operational missile target of proven reliability for a wide range of needs

Designed to meet advanced weapon systems training and evaluation requirements, the Beech KDB-1 has demonstrated its reliability in a wide variety of missions. With a top speed of 345 mph and flight endurance of more than one hour, the KDB-1 has the versatility required to fulfill a wide range of missions in addition to those shown above. It can fly at altitudes in excess of 40,000 feet and can carry payloads of up to 200 pounds and up to 4 cubic feet.

Already operational and simple to use, the KDB-1 can be supplied rapidly to field commanders and can be operated by relatively unskilled people. All equipment and tools required for ground support are fully developed, available and ready for use.

Beech Aerospace Division

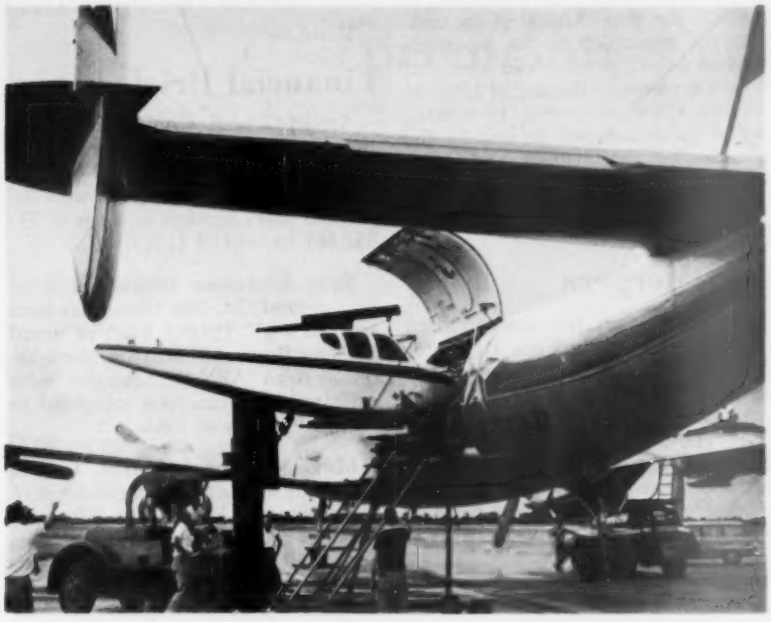
BEECH AIRCRAFT CORPORATION • WICHITA 1, KANSAS.

equipment including cathode ray tube oscilloscopes, industrial cathode ray tubes and associated electronic devices, and other electronic equipment used in conjunction with autopilots for jet and piston engine aircraft. The company is also engaged in defense production and defense research and development contracts dealing with electronic countermeasure equipment, precise navigation instruments and other electronic items. Offering is 100,000 shares of common stock, for public sale at $5 per share. Proceeds will be used primarily to accelerate the development of the company's proprietary items for the purpose of expanding its commercial business. It is estimated that $100,000 will be allocated to research and development costs for new proprietary items of electronic equipment; $150,000 to acquire components for the manufacture of new electronic equipment presently under development; part will be used to increase sales personnel, and the balance for general corporate purposes.

Bristol Dynamics, Inc., Brooklyn, N. Y., engaged in designing, engineering, manufacturing, producing and selling electrical and mechanical assemblies, electronic and missile hardware components and special tools and fabrications. Offering is 124,000 shares of common stock for public sale at $6 per share; 69,000 shares to be offered for the account of the company, and 55,000 outstanding shares by the present holders thereof. Of the proceeds $100,000 will be used for expansion and further modernization of the company's plants and equipment; $100,000 for research and development of new products; the balance (about $123,000) for working capital and other corporate purposes.

Electro-Tec Corp., South Hackensack, N. J., engaged in the design, development, manufacture and sale of slip ring and brush block assemblies, switching devices and relays for electronic equipment. Offering is 135,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the offering, 75,000 shares are to be offered for the account of the company, and 60,000 outstanding shares by the present holder thereof. Proceeds will be added to the company's general funds and used for general corporate purposes. Also approximately $750,000 will be used for construction of a new plant in New Jersey to replace leased facilities in South Hackensack, and approximately $50,000 will be used for additional tooling of relay production facilities.

Harvey Aluminum (Inc.), Torrance, Calif., producer of primary aluminum and fabricating aluminum products, zirconium products for use in nuclear reactors and titanium products for sale primarily to the aircraft and missile industries. Offering is 750,000 shares of A common stock for public sale at



Beech Ships Four Planes to Germany

Beechcraft Debonair Model 33 fuselage is loaded into a Lufthansa Lockheed Super Constellation 1649 freighter at Wichita, Kan., for shipment to Bremen, Germany. Four planes, one M35 Bonanza and three Debonairs, were shipped on this flight. A specially built rack held the four sets of wings. Cargo included several tons of spare parts.

BASIC BUILDING BLOCKS FROM KEARFOTT

SIZE 11 MOTOR GENERATOR

Featuring 300:1 Signal-to-Noise Ratio

The high performance Size 11 Servo Motor Generator features 0° phase shift and a signal-to-noise ratio of 300:1. It is designed primarily to replace Size 15 units in high gain damping applications. In-phase speed-sensitive output variations due to temperature variations are stabilized to within 0.2%/°C over the temperature range and speed-sensitive voltage and frequency variation are stabilized to within ±0.2% for voltage and 0.03%/cycle for frequency.

ELECTRICAL CHARACTERISTICS

MOTOR	Fixed Phase	Control Series	Phase Parallel
Voltage (volts)	115	36	18
Frequency (cps)	400	400	400
Current (ma)	53	155	310
Power Input (watts)	3.5	3.5	3.5

GENERATOR		
Excitation	115 volts	400 cps
Volts Out at 1000 RPM	2.9V	
Phase Shift at 2600 RPM	0°	
Null Fundamental RMS	5MV 10MV	
Linearity 0-3600 RPM	0.2%	

MECHANICAL CHARACTERISTICS

No Load Speed	5500 RPM
Stall Torque	0.55 Oz. In.
Rotor Moment of Inertia	7.7 gm cm^2
Theoretical Acceleration	12,800 rad/sec^2
Weight	9 oz.

Write for complete data.

KEARFOTT DIVISION
GENERAL PRECISION, INC.
Little Falls, New Jersey

USAC TRANSPORT INC

U.S.A.C. TRANSPORT TRUCKS HAVE CARRIED

V-2
NIKE AJAX
NIKE HERCULES
TALOS I
TALOS II
MATADOR
MACE
LA CROSSE
REDSTONE
JUPITER
JUPITER C
CLASSIFIED
HONEST JOHN
LITTLE JOHN
REGULUS I
REGULUS II
DRONES
QUAIL
PETREL
SPACE CAPSULES
SOLID PROPELLANT
RADIAL CYLINDER
JET THRUST and
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RATO and JATO
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Bristol Type 188 Research Aircraft Nacelle

Engine nacelle for the Bristol Type 188 supersonic research aircraft will house the de Havilland Gyron Junior turbojet engine and afterburner. Stainless steel nacelles which will house the aircraft's two powerplants are 3 ft. 9 in. in diameter at their widest point.

$22.75 per share. Proceeds will be added to the general funds of the company for application to the expansion program now in progress and scheduled to be completed by the end of 1960; to the extent not so applied, to working capital and as such will be used for the payment of indebtedness and other corporate purposes.

Acquisitions And Mergers

Litton Industries, Inc., has purchased a majority interest in Fritz Hellige & Co., GmbH., West German manufacturer of advanced electronics equipment, for an undisclosed amount of cash. The company is located at Freiburg-im-Breisgau in southwestern Germany, is housed in a modern, five-story building of 85,000 sq. ft., and has 420 employes.

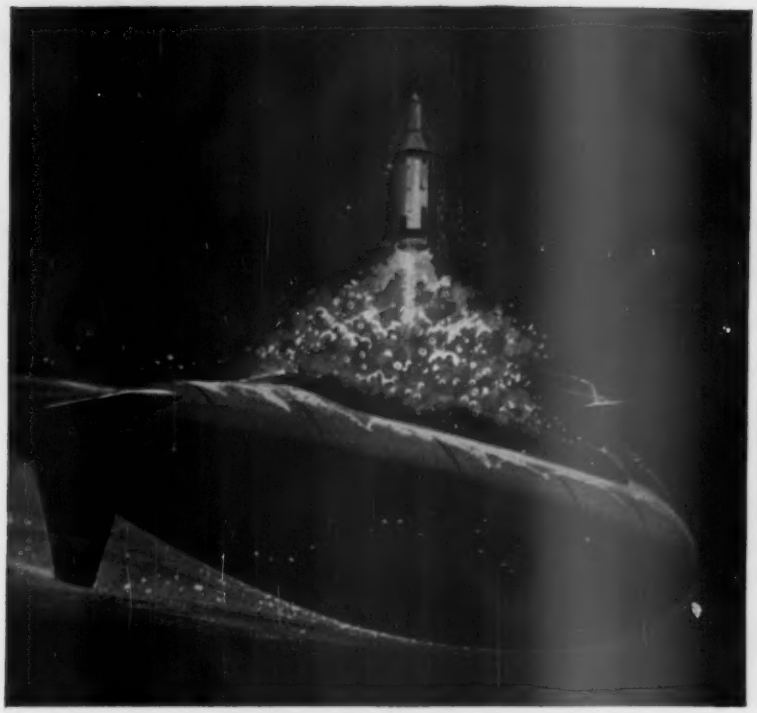
Houston Fearless Corp. has acquired Marchetti Associates, a Boston electronics research-engineering company formerly affiliated with Avco Corp.'s Crosley Division. Terms of the acquisition were not announced. Houston Fearless' federal group, headquartered in Boston, will be responsible for administrative direction of the Marchetti operation.

Financial Briefs

Aerojet-General Corp. earnings for the six months ended May 31 were $4,456,556 on consolidated sales of $200,511,325. This compares with the previous year's first-half earnings of $3,832,661 on sales of $154,636,267.

Ryan Electronics Division of Ryan Aeronautical Co., San Diego, has been awarded a $17,350,000 letter of intent by Navy Bureau of Weapons for additional Ryan APN-122 doppler radar navigators. Deliveries are scheduled to start in February of 1961.

Idaho Maryland Industries, Inc., is new name approved by stockholders of Idaho Maryland Mines Corp. The company has added the following divisions: Ferro Cast, producer of precision castings for aircraft and missile applications; Magnetics, producer of precision memory systems and magnetic heads, and Universal Research & Testing Laboratories, an environmental testing facility. Space Systems & Industrial Automation, a new subsidiary, is engaged in research, analysis and development.



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POLARIS FBM

DISCOVERER SATELLITE

EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY

ADVANCED PROJECTS AT LOCKHEED

POLARIS FBM — Now in its advanced development status, the Navy-Lockheed POLARIS Fleet Ballistic Missile is scheduled to be fully operational and aboard its specially designed submarines late this year. Full-scale test vehicles have been successfully flown on a regular schedule of firings for months with only two failures, a remarkable achievement in view of the totally different environmental problems involved in its underwater launch. With nearly three-quarters of the earth's surface being water, practically no target in the world is outside the POLARIS' range of over 1200 nautical miles. The Division is systems manager for the POLARIS under the direction of the Special Projects Office of the Navy.

SATELLITE PROGRAMS — The Air Force-Lockheed AGENA satellite is a versatile space vehicle capable of numerous assignments. In its present DISCOVERER program configuration, it is 19 feet long, 5 feet in diameter with an orbital weight of approximately 1700 pounds. Payload of several hundred pounds includes telemetry, instrumentation, guidance and attitude control systems, reentry vehicle and recovery capsule. The AGENA has accomplished several significant space "firsts." It was first to be placed on the difficult polar orbit; first to be placed on a precise, predicted, and nearly circular orbit; first to change its attitude on orbit, with a turn of 180 degrees and a downward tilt of 60 degrees; first to eject a capsule; and first to prove advanced space systems such as ground-space communications, instrumentation, attitude and guidance and life-sustaining devices. The AGENA can be modified for a variety of space missions such as navigation; geophysical investigations; lunar probes; long-range communications; and space probes.

In addition to the DISCOVERER program, the Division is developing advanced AGENA satellites for the MIDAS program (Missile Defense Alarm System) and the SAMOS strategic warning system. Lockheed is system manager and prime contractor for these projects under the direction of the Air Force Ballistic Missile Division (ARDC).

SPACE STATION — An orbiting research facility to serve as an advanced base for space exploration, has been proposed in practical detail by Lockheed's research and development staff. The station would carry a 10-man crew. Prefabricated compartments for the rim of the wheel, the spokes, and the three hubs would be launched separately by ballistic missiles and assembled in space by means of the specially-designed, Lockheed Astrotug.

X-17, KINGFISHER, X-7 — The Air Force-Lockheed X-17 solid-propellant ballistic missile has pioneered many new techniques, and the valuable experience gained from this program facilitated development of other, inter-service projects, including the Navy POLARIS FBM. The Navy's Project Argus radiation explosion featured the X-17 as the vehicle. Developed for the Air Force, the Lockheed KINGFISHER is designed to simulate enemy attacks to test our nation's anti-bomber and anti-guided-missile defenses. The Air Force X-7 is a unique, recoverable ramjet-engine test vehicle designed to test new developments in advanced components for other missiles.

The successful completion of projects such as these requires a bold and imaginative approach to entirely new environments. Lockheed's programs reach far into the future. It is a rewarding future which scientists and engineers of outstanding talent and inquiring mind are invited to share. Write: Research and Development Staff, Dept. G-17A, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

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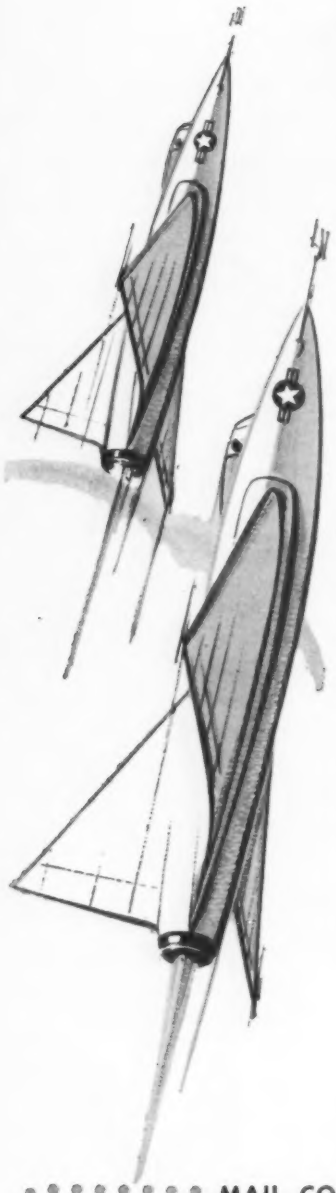

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Stock Transactions

The Securities and Exchange Commission reported the following additional transactions during the period from Mar. 11 to Apr. 10, 1960:

Texas Instruments, Inc. Disposition (private transaction) of 900 common shares by Patrick E. Haggerty, officer and director, leaving a holding of 121,075; disposition of 2,200 common shares by S. T. Harris, officer, leaving a holding of 20,020 (indirect holdings in trusts remain 1,017); disposition (private transaction) of 5,000 common shares by J. E. Jonsson, officer, leaving a holding of 374,132; disposition (private transaction) of 5,000 common shares by Eugene McDermott, director, leaving a holding of 296,328.

Thiokol Chemical Corp. Disposition of 500 common shares by J. S. Jorczak, officer and director, leaving a holding of 5,824; disposition of 7,000 common shares by Robert Lang, director, leaving a holding of 329,912.

Thompson Ramo Wooldridge, Inc. Disposition of 400 common shares by Irwin A. Binder, officer, leaving a holding of 2,000; acquisition of 1,000 common shares by Horace A. Shepard, officer, making a holding of 5,400; acquisition of 500 common shares by J. D. Wright, director, making a holding of 10,838 (indirect holdings in trust remain 3,500).

Western Air Lines, Inc. Acquisition of 321 capital shares by T. C. Drinkwater, officer and director, making a holding of 6,753; acquisition of 300 capital shares by Harry J. Volk, director, making a holding of 2,408.

Transactions reported during the period from Feb. 11 to Mar. 10, 1960, included:

Allegheny Airlines, Inc. Acquisition of 1,000 common shares by Robert F. George, director, making a holding of 52,100; acquisition of $1,500 of convertible debentures by Edwin L. Colodny, officer, making a holding of $1,500; acquisition of $1,000 of convertible debentures by Richard G. Dinning, officer, making a holding of $1,000; acquisition of $1,000 of convertible debentures by Walter J. Short, officer, making a holding of $1,000.

Avco Corp. Acquisition of 600 common shares by Edward H. Litchfield, director, making a holding of 1,000; acquisition of 100 common shares by Malcolm A. MacIntyre, director, making a holding of 100; acquisition of 6,000 common shares through exercise of option by Matthew A. McLaughlin, officer, making a holding of 9,375; acquisition of 1,000 common shares through exercise of option by John Mihalic, Jr., making a holding of 6,300.

Chance Vought Aircraft. Acquisition of 200 common shares by Gifford K. Johnson, officer and director, making a holding of 250; acquisition of 1,000 common shares by Charles J. McCarthy, officer, making a holding of 1,000; acquisition of 100 common shares by W. P. Thayer, officer, making a holding of 100.

Collins Radio Co. Acquisition of 500 common shares by M. L. Doelz, officer, making a holding of 504; acquisition of 500 common shares by J. G. Flynn, Jr., officer and director, making a holding of 1,508; disposition of $15,000 of 5% convertible debentures, his total holdings, by Arthur A. Collins, officer, director and beneficial owner.

Douglas Aircraft Co., Inc. Disposition of 1,866 capital shares by Arthur E. Raymond, officer and director, leaving a holding of 9,000.

General Electric Co. Disposition of 2,000 common shares by William S. Ginn, officer, leaving a holding of 6,168 (indirect holding remains 407); disposition of 1,011 common shares by William Allen Mann, officer, leaving a holding of 1,252; disposition of 750 common shares by Clarence C. Walker, officer, leaving a holding which amounts to 6,923.

Dassault 410 Spirale Equipped for Combat

Dassault 410 Spirale, military version of the Dassault Communaute liaison aircraft, is shown (above) equipped with four Matra 361 rocket launchers and (below) taking off with a pair of 880 lb. bombs. Spirale is powered by two Turbomeca Bastan turboprops rated at 1,000 eshp. each. Aircraft was designed specifically for use in Algeria, but no military orders have been received to date.

General Precision Equipment. Disposition of 200 common shares by Joel Dean, officer, leaving a holding of 1,400; acquisition of 800 common shares by The Martin Co., making a holding of 186,500; acquisition of 250 shares of $4.75 preferred by John C. Maxwell, director, in partnership, and disposition of 320 shares of $4.75 preferred, leaving an indirect holding of 20 short.

Lear, Inc. Disposition of 939 common shares, his total holding, by Paul Moore, officer; acquisition of 222 common shares, bonus, by Joseph M. Walsh, officer, and disposition of 523 common shares, his total holding.

Lockheed Aircraft Corp. Acquisition of 480 capital shares through exercise of option by Erle M. Constable, officer, making a holding of 680.

Microwave Associates. Disposition of 800 common shares by Julian Pathe, officer, leaving a holding of 10,300.

North American Aviation, Inc. Acquisition of 100 capital shares by Henry B. DuPont, director, making a holding of 3,466; disposition of 100 capital shares by S. K. Hoffman, officer, leaving a holding of 500.

Northwest Airlines, Inc. Disposition of 100 common shares by Hadley Case, director, leaving an indirect holding of 18,000; disposition of 1,000 common shares by Frank C. Judd, officer, leaving a holding of 1,005; disposition of 1,900 common shares by A. J. Weatherhead, Jr., director, leaving a holding of 1,250 (amended report); disposition of 300 shares of 5¼% cumulative preferred by Hadley Case, director, leaving an indirect holding of 23,700.

Pan American World Airways. Acquisition of 1,875 capital shares through exercise of option by John C. Leslie, officer and director, making a holding of 6,375; acquisition of 500 capital shares by John Charles Pirie, officer, making a holding of 2,880.

Raytheon Co. Acquisition of 945 common shares through exercise of option by David D. Coffin, officer, making a holding of 3,631; acquisition of 5,014 common shares through exercise of option by Ivan A. Getting, officer, making a holding of 5,394.

Sperry Rand Corp. Disposition of 1,000 common shares by Albert H. Rumble, officer, leaving a holding of 8,000.

Texas Instruments, Inc. Disposition of 810 common shares by W. D. Coursey, officer, leaving a holding of 5,945; disposition of 800 common shares of W. F. Joyce, officer, leaving a holding of 11,262; disposition of 475 common shares by C. J. Thomsen, officer and director, leaving a holding of 12,138.

Thiokol Chemical Corp. Disposition of 1,500 common shares by S. M. Martin, Jr., officer and director, leaving a holding of 24,101.

United Air Lines, Inc. Disposition of 1,200 common shares by R. F. Ahrens, officer, leaving a holding of 1,631.

Western Air Lines, Inc. Acquisition of 100 common shares by H. C. Haight, director, making an indirect holding of 204; acquisition of 100 common shares by William C. Jennings, officer, making a holding of 100; acquisition of 18,002 common shares (exchange) by Dudley Swim, director, making a holding of 22,711 and disposition of $339,000 of 4½% convertible debentures, his total holding.

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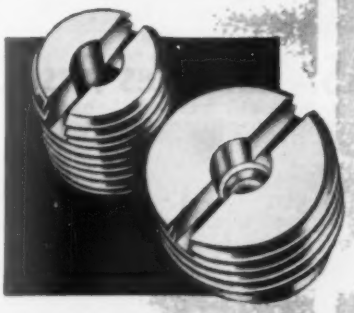

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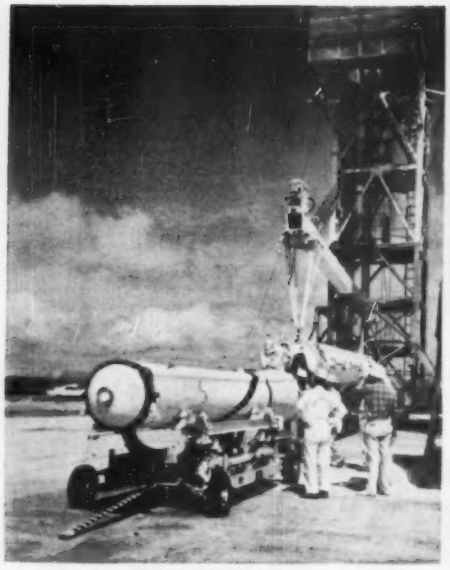
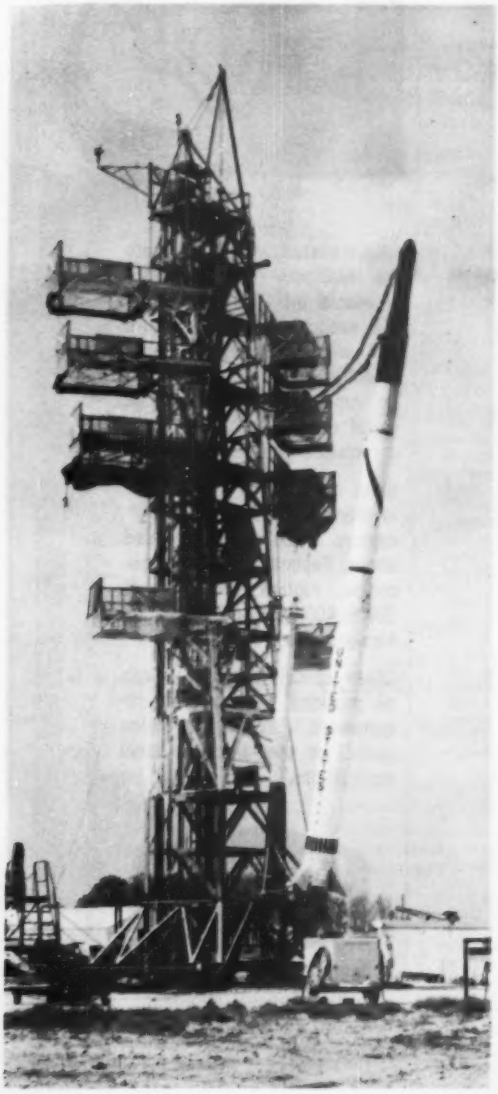
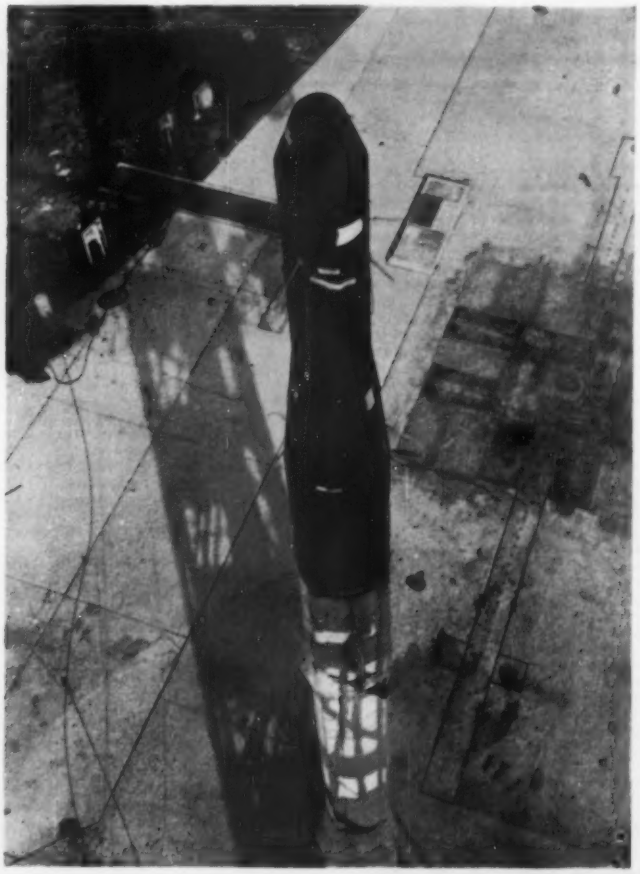


NASA Launches First Complete Prototype Scout Research Rocket



First firing of three controlled solid propellant stages of Scout rocket vehicle took place at Wallops Station, Va., on July 1 as part of a NASA program to develop a small, reliable and flexible solid-fuel research vehicle designed for a variety of space exploration missions. The 72-ft. Scout carried a 193-lb. payload. Ignition of the fourth stage was prevented by command when the vehicle appeared to veer off course. NASA officials said that Scout reached an altitude of at least 860 mi. and a range of approximately 1,500 mi. Excellent telemetry was obtained through the flight of the first three stages of the 36,100-lb. vehicle.



CAB Accident Investigation Report:

CAB Revises Earlier TWA Crash Report

Trans World Airlines Flight 260, a Martin 404, N 40416, struck Sandia Mountain, near Albuquerque, N. M.,[1] Feb. 19, 1955, about 0713.[2] All 16 occupants were killed and the aircraft was destroyed (AW Nov. 28, 1955, p. 80).

An investigation was initiated by the Civil Aeronautics Board immediately after the accident. This included examination of the wreckage at the crash site which was discontinued because of deep snow and dangerous footing in the mountainous terrain. On May 3, 1955, a second trip was made to the scene of the accident and study of the wreckage was continued. On Oct. 12, 1955, the Board's Accident Investigation Report was released. The probable cause was determined to have been lack of conformity with prescribed en route procedures and a deviation from airways at an altitude too low to clear obstructions ahead.

Because of controversy over certain elements of the report of Oct. 12, 1955, additional study was given to the facts and circumstances of the accident and an amended report thereon was issued by the Board on Aug. 26, 1957. The probable cause of the accident in this report was identical to that of the first report although the analysis portion was altered to revise the statement that the direct course was intentional.

On Oct. 10, 1958, the Air Line Pilots Assn. presented to the Bureau of Safety certain factual information and theories concerning the cause of the accident. On Nov. 24, 1958, a third trip to the accident site was made. While there a new determination was made of the airplane's heading at the time of impact. Because of these developments since the Aug. 26, 1957, accident report was issued, active investigation and study was resumed.

Additional Testimony

Additional testimony and documentary material were received from representatives of the ALPA, TWA, CAB, Eclipse-Pioneer Division of the Bendix Aviation Corp., and the Collins Radio Co. at Kansas City, Mo., on Jan. 15 and 16, 1959. In addition, a later study and presentation of facts concerning the instrumentation of the airplane and an analysis of tests made of the fluxgate compass system by Eclipse-Pioneer and ALPA were considered.

After an analysis of all new evidence and the original record, it is the Board's decision that a supplement to its accident report be issued. This is in conformance with the Board's policy and rule that accident investigations are never officially closed but are kept open for the submission of new and pertinent evidence by any interested party.

The Board, in this supplemental analysis, has reviewed considerable testimony and information supplied by interested parties. The ALPA presented a detailed review of the Board's report and advanced several theories to account for the flight path deviation. In the light of additional information and further study, the Board believes that certain matters in the report need to be amended and are corrected in the discussion which follows:

1. **Copilot Experience:** The Board's amended report of Aug. 26, 1957, gave Copilot Creason's experience over the Albuquerque-Santa Fe route only for the month of the accident and for the previous month. It did not mention his flying that route during previous years. He had flown the Albuquerque-Kansas City route a total of 32 trips and the Albuquerque-Santa Fe route a total of 24 trips. Obviously, he was familiar with the route and the adjacent terrain, as was Captain Spong.

2. **Airplane Heading:** During the third visit to the crash site, on Nov. 24, 1958, the heading at the time of impact was determined to be 249 deg. magnetic. This direction was determined by a sun compass not subject to magnetic forces or their local variations. Previously the direction was believed to be 320 deg. as determined by a magnetic compass.

From this it is evident that the aircraft must have been turned to the left from about 35 deg. magnetic, the direction in which it approached the mountain, through some 145 deg., when it struck. This is nearly a reversal of course and must have been brought about by the pilot's sudden realization of proximity to the high land. This realization could have come from a glimpse of the ground, from warning by the terrain warning indicator, or from sudden awareness of course error by reference to the flight instruments and the indications of radio navigational aids.

3. **Weather:** A detailed review of the official weather observations as taken at Kirtland Field, Albuquerque, and the observations of ground witnesses indicate that weather conditions directly over Kirtland Field and throughout the western semicircle (from Kirtland) were good. The 0708 weather observation showed scattered clouds at 4,000 ft. with thin broken clouds above based at 7,000 ft. and a prevailing visibility of 40 mi. The Sandia Mountains were obscured by clouds during virtually the entire duration of the flight. Various ground witnesses described the cloud conditions over and near the mountains as covering all but the bases or foothills of the mountains with slightly more of the mountain bases visible along the extreme northern end of the Sandias. The cloud bases adjacent to the mountains were further characterized as ragged and there were snow showers present near the mountains, further restricting visibility in this quadrant. In summary, the only weather of any consequence near Albuquerque was the clouds and snow showers which had developed owing to orographic effect over and in the immediate vicinity of the Sandia Mountains.

4. **Fluxgate Compass System:** The ALPA has suggested several theories which it believes can account for the flight path of the aircraft, all of which are based fundamentally on a malfunction of the fluxgate compass system. A detailed discussion of these follows:

Headed Toward Mountains

Upon takeoff from Albuquerque, a right turn was made which carried the aircraft around the airport until it reached a position in the vicinity of the northwest corner of the airport at which time the aircraft took up a heading toward the mountains. The aircraft was observed flying on this heading until lost from view upon entering the clouds that concealed the mountains.

Since deviation from the prescribed route occurred at the beginning of the flight, while the aircraft was in the immediate vicinity of the airport of departure, attention must be focused on this segment of flight to determine the most probable condition or set of conditions present at the time that could cause the crew to continue the turn after takeoff beyond the proper point and assume and maintain a heading that resulted in a course leading to the mountains.

Clearly, the crux of the matter lies in the reason for the initial departure heading. Since the crew receives heading information through two fluxgate compass systems, consideration must be given to the possibility of the crew's having responded to erroneous information from these systems. Also, in view of the clear weather in the immediate vicinity of the airport, consideration must also be given to the possibility of the crew's having taken up the initial heading visually by rolling out of the turn after takeoff on a course approximately parallel to what was mistakenly thought to be the north-south runway, but was the northeast-southwest runway.

This proposition presupposes a considerable period of visual reference with the airport during the turn after takeoff. Whether this be continuous or intermittent observation, it would provide an opportunity for the crew to detect its error through reference to familiar landmarks on the airport and sections of the city adjacent to it. Further, if valid heading information was being furnished by the compass systems, the substantial disparity between desired heading and indicated heading would serve to alert the crew to the error when they subsequently checked aircraft heading

[1] This report is supplementary to the Board's report released Aug. 26, 1957.
[2] All times herein are Mountain Standard based on the 24-hr. clock.

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by reference to the RMI[a] or MDI. Considering the first possibility, that of erroneous heading information from the aircraft's compass systems, we find a more plausible explanation for the assumption of an erroneous heading as well as the failure to detect the error quickly. Further, as will be detailed, erroneous information from but one of the two compass systems need be assumed.

The misinformation envisioned is of the type produced as the result of a tilted fluxgate transmitter gyro. Proper heading information is dependent upon the sensing element being held at all times in a horizontal plane. Stability of the element is obtained through the use of a small gyro within the fluxgate transmitter. The gyro is of the self-erecting type and an additional quick erection feature is provided in the form of a caging mechanism electrically operated and controlled by a switch in the cockpit. This latter mechanism, employed prior to takeoff, erects the gyro to the nearly vertical position, leaving its final position to the self-erection feature.

Although malfunctioning of a fluxgate transmitter can produce a gyro tilt condition, the operating conditions of the transmitter assemblies on the subject aircraft remain unknown since only parts of one assembly were recovered.

It has been demonstrated that it is possible that when first energized the gyro can assume a tilt angle that will produce correct heading information when the aircraft is on the takeoff runway, but will indicate erroneously as the aircraft assumes other headings. Thus failure to erect the gyro by means of its caging system before takeoff can result in varying degrees of indicated heading error dependent upon actual aircraft heading, relative strengths of horizontal and vertical components of the earth's local magnetic field, and upon the degree and direction of gyro tilt. Eventually, these errors diminish in magnitude until they become nonexistent as the gyro responds to its self-erection mechanism. However, at the relatively low self-erection rate of the gyro (averaging approximately two degrees per minute) it is possible that an aircraft could become airborne before the gyro is fully erected.

Also to be considered is the possibility of gyro tilt as the result of a caging cycle taking place while the aircraft is banked. Had such an action occurred during the period that the aircraft was in its turn after takeoff, either as the result of crew action or system malfunction, erroneous heading information would be displayed until the gyro had again been erected by its self-erection feature. Further, the error produced under these circumstances is one that would necessitate the aircraft being flown on a northeasterly heading in order for the compass system to indicate a northerly heading.

Heading information from the fluxgate compass systems is supplied by four instruments; an MDI and an RMI on each pilot's instrument panel. The MDI's receive heading intelligence from separate fluxgate transmitters located in the left wing tip. The RMI is a slave instrument which receives its heading intelligence from an MDI. In the subject aircraft both RMI's were

[a]RMI—Radio Magnetic Indicator
MDI—Master Direction Indicator

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P.O. Box 358 Sunnyvale, Calif.

normally slaved to the copilot's MDI which in turn received heading intelligence from the inboard (No. 2) fluxgate transmitter. A selector switch was provided for emergency transfer of the RMI's to the captain's MDI, which receives its intelligence from the outboard (No. 1) fluxgate transmitter.

It is apparent that the aforementioned transmitter-indicator relationship would, in the event of a tilted gyro in No. 2 fluxgate transmitter, permit the display of erroneous but identical heading indications on three of the four heading indicators, the copilot's MDI and RMI, and the captain's RMI. The captain's MDI would, however, show a heading which was different from these three instruments.

The front end housing of one RMI was recovered at the accident site. Although its glass and pointers were missing, the bezel, mask, and dial were still in place. Careful study of these damaged parts indicated that the dial reading was approximately 272 deg. at the time of impact. This reading is 23 deg. from the recorded impact heading of the aircraft which, as previously mentioned, was measured as approximately 249 deg. magnetic. Considering such unknown factors as the amount of aircraft heading change after destruction of the RMI, and the accuracy of the aircraft centerline as established within the wreckage area, it may be concluded that the RMI heading indication was substantially correct at the time of impact.

This finding does not preclude the possibility that erroneous compass information due to gyro tilt caused the crew to take up a course toward the crash site. Such initial error could have been considerably reduced in magnitude by action of the self-erection feature of the gyro as the aircraft proceeded toward the mountains, or it could have been completely removed through operation of the caging mechanism. This latter might well have occurred if the captain noted a disparity between heading indications displayed on his MDI and RMI. It would be entirely reasonable to expect that he would, under these circumstances, actuate the caging mechanisms of both compass systems to determine which system was in error.

5. **Use of Available Navigational Aids:** The Board believes that the crew intended to follow the route prescribed in the ATC clearance. This is confirmed by their care in verifying the location of the Weiler intersection, a reporting point in their clearance, by the airplane's radio receivers being found set properly for this route of flight and because the crash occurred at about 9,000 ft., the planned cruising altitude. Further, it is inconceivable that a crew familiar with the terrain features in the Albuquerque area, as was this crew, would have taken a direct route to Santa Fe at an altitude of 9,000 ft.

Each RMI is fitted with two rotatable pointers that may be used to display either ADF or VOR bearings.

Two ADF and two VHF navigation receivers were installed in the aircraft and were designated No. 1 (captain's) and No. 2 (copilot's). Each RMI was provided with a selector consisting of two toggle switches, one for each pointer. The single pointer indicated either No. 1 ADF or No. 1 VOR bearings depending upon the position of its toggle switch. Similarly, the double pointer could be used for either No. 2 ADF or No. 2 VOR.

Mounted directly below each RMI was a flight path deviation indicator (FPDI) the vertical needle of which responded to course displacement information derived from either the No. 1 or No. 2 VHF navigation receiver as selected by a toggle switch mounted adjacent to the instrument.

One omni bearing selector (OBS) was mounted on each pilot's panel; the one on the captain's side was used in conjunction with No. 1 VHF navigation receiver, and that on the copilot's side was used in conjunction with the No. 2 VHF navigation receiver.

Although the settings of the RMI and FPDI selector switches are not known, some understanding of the technique used by the crew in this departure and of the navigation aids available to them may be deduced from a study of the factual information obtained during the investigation.

Copilot Flying

The No. 2 VHF navigation receiver was tuned to the frequency of the Albuquerque ILS localizer and the No. 1 VHF receiver was tuned to the frequency of the Albuquerque VOR. Since the FPDI selector switches are typically positioned so as to connect the instruments to their respective receivers (captain's to the No. 1 and copilot's to No. 2) it may be assumed that the copilot was flying the aircraft with the en route information displayed on his panel while the captain's panel was set to display the crossing of the 026-deg. radial of the ABQ VOR (Weiler intersection). This latter assumption is further strengthened by finding the captain's OBS set to either 026 deg. or its reciprocal 206 deg.

In addition to course deviation information, each crew member could display on the single pointer of his RMI the magnetic bearing to the Albuquerque omni station.

The No. 1 ADF receiver was found tuned to the frequency of the compass locator at the outer marker of the Albuquerque ILS. Its function switch was in ADF position. No 2 ADF receiver was tuned to the frequency of the Albuquerque low frequency range station; however, its function switch and sensitivity selector were both found in the "off" position.

This indicates that the crew was using No. 1 ADF during the flight and therefore that at least one of the crew members had selected his RMI single pointer to display the bearing to the outer marker. It is probable that the copilot would want such information displayed on his RMI to assist in his en route navigation while the captain would probably select No. 1 VHF navigation receiver for his single pointer to provide continuous relative bearing indication to the Albuquerque omni to assist in his identification of the Weiler intersection.

Any error in magnetic heading information received from the fluxgate compass system due to gyro tilt would also be introduced into the RMI pointer when selected to VOR. This would result in the pointer following the compass card so as to indicate the magnetic bearing to the station. Under such circumstances it would not point to the station. As a result, the crew would

not initially see an incongruous presentation on the RMI despite the magnetic heading error. However, if the pointer were selected to ADF position, it would point to the station regardless of compass system error and should serve to alert the crew of any substantial heading error.

In summary, the aircraft's radio navigational receivers were determined to have been set as follows:

a. The copilot's VHF receiver was set to the Albuquerque ILS frequency. This would enable the pilot to utilize the back course of the ILS localizer.

b. The captain's VHF receiver was set to the Albuquerque omni station and his OBS was set at either 026, or 206 deg., the reciprocal. This would enable a check to be made of the Weiler intersection as specified in the IFR clearance.

c. The No. 1 ADF receiver was tuned to the outer marker of the ILS. This would permit use of a tail bearing to determine when the aircraft was on the proper departure course.

The Board recognizes that the theory of the fluxgate compass error advanced by the ALPA can not be disproven. Such error may account for the initial directional error of the flight heading the aircraft toward the Sandia Mountains. However, it can not account for the continued flight long past the time the crew should have noticed the error.

Other Factors

Several other factors must be considered along with this error to account for the continuance of this flight on the erroneous heading:

First: The magnetic compass could have been used as a cross-check for heading information.

Second: Terrain features such as the appearance of the city area, the river bed more or less paralleling the correct course, and the railroad track to the right of the correct course, could have been noted. The weather was quite clear for an ample period of time to alert the crew they were off course had they referred to ground features. In addition, it may be pointed out that this type of initial check immediately after departure might well be most pertinent inasmuch as the precipitous Sandia Mountains, then hidden by clouds, lie adjacent to the correct course and are, as a matter of fact, the highest terrain between Albuquerque and Santa Fe.

Third: The MDI on the captain's instrument panel would indicate a different heading from that of the RMI and could have been noted and should have alerted the crew that an error was present in one of the systems.

Fourth: The FPDI on the copilot's panel would have moved from the full fly-right position to the full fly-left position as the aircraft crossed through the localizer course north of the airport. This should have alerted the crew that they were proceeding away from the heading of the localizer and that it would be necessary to turn back to the left in order to arrive at the Weiler intersection in accordance with their clearance.

Again, in order to accept the theory offered, the Board must conclude that both crew members were completely oblivious to all these indications, that their attention was focused entirely on the RMI, and that they did not cross-check any other flight instruments.

One other possibility, advanced by ALPA, remains which the Board also considered in this study. It is the possibility that the pilot became confused with respect to the proper sensing of the FPDI during a back course departure on the ILS. On a back course approach the FPDI would indicate a reverse reading from the normal approach. However, in departing on the back course the indications received in the FPDI would be exactly the same as an approach made normally on the front course. Even if this confusion did exist, the normal cross-checks outlined above were still available and should have alerted the crew, providing they were conducting the flight according to prescribed procedures and accepted good operating practices.

In view of the foregoing discussion, the Board believes that the former report did not accurately reflect all the circumstances of this accident. It is believed that insufficient evidence exists to substantiate the reason for the deviation from the prescribed flight path. The probable cause therefore will be changed accordingly.

The Board determines that the probable cause of this accident was a deviation from the prescribed flight path for reasons unknown. By the Civil Aeronautics Board:

WHITNEY GILLILLAND, Chairman
CHAN GURNEY, Vice Chairman
G. JOSEPH MINETTI, Member
ALAN S. BOYD, Member

Idlewild Seeks Jet Takeoff Weight Rule

New York—The Port of New York Authority has recommended that the takeoff weights of jet transports departing New York International Airport be limited by federal regulation when necessary to hold down noise above neighboring communities.

Commenting on a noise abatement procedure proposed for Idlewild by the Federal Aviation Agency (AW May 16, p. 41), the Port Authority charged FAA with failing to recognize the part played by aircraft weight in determining takeoff noise.

"Specifically," the Port Authority went on to say, "aircraft dispatchers should be required to take the runway preference rules, the distance to the nearest community and the maximum permissible noise levels into account when computing the maximum takeoff weight for any particular flight."

The Port Authority admitted that its own proposal "might involve economic considerations" when carriers cut back payloads to keep aircraft noise within prescribed limits.

A maximum noise level of 112 "perceived noise decibels" measured from the ground is the Port Authority's present standard for permissible takeoffs during daylight hours.

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WHO'S WHERE

(*Continued from page 23*)

Changes

Dr. Peter Fortescue, chief research and development engineer of the newly organized General Atomic Europe, Zurich Switzerland. Dr. Fortescue continues as chief research and development engineer of General Atomic Division of General Dynamics Corp., San Diego, Calif.

Capt. George D. Cheetham, system chief pilot, Braniff International Airways. Also: **Capt. M. G. Safrit,** assistant system chief pilot; **Capt. James W. Peckham,** assistant chief pilot.

Prof. Thomas Gold, a special consultant to National Research Corp., Cambridge, Mass. Prof. Gold is chairman of Cornell University's department of astronomy and director of the radiophysics and space research center.

H. C. Cotton, manager-advanced systems, Ryan Aeronautical Co., San Diego, Calif.

Joseph Robert Lewis, director of engineering, Sierra Electronic Division of Philco Corp., Menlo Park, Calif.

A. J. Kullas, engineering technical director-rocket booster portion-Air Force Dyna-Soar program, The Martin Co., Baltimore, Md.

Frederick P. Morgan, manager of operations, Convair/Pomona, Convair Division of General Dynamics Corp., Pomona, Calif.

British Aircraft Corp., Ltd., has announced the following appointments: **Geoffrey E. Knight,** commercial manager; **Eric L. Beverley,** sales manager (guided weapons); **Reginald H. Sawyer,** chief accountant.

Richard P. Thornton, general manager, Packaged Electronics Division of Amphenol-Borg Electronics Corp., Broadview, Ill.

Dr. Solomon L. Miller, head of the research section, Research and Development Department, Rheem Semiconductor Corp., Mountain View, Calif.

William Fitzwater, Jr., senior design specialist, Epsco-West, Anaheim, Calif.

Laurence H. Cherry, associate director of marketing, Grand Central Rocket Co., Redlands, Calif.

Dr. Edward M. Pritchard, director of engineering, Military Systems-Stavid Division of Lockheed Electronics Co., Plainfield, N. J.

Victor H. Harris, manager, New Products Office of Vitro Laboratories, West Orange, N. J.

Joseph A. Small, sales manager, Aircraft and Missile Support Department, the Hallicrafters Co., Chicago, Ill.

Leonard F. Griffith, chief engineer, Airaterra, Glendale, Calif.

Arthur H. Williams, director of research and development, Shafer Bearing Division of Chain Belt Co., Downers Grove, Ill., and **Robert F. Hunter,** chief engineer.

International Electric Corp., a subsidiary of International Telephone and Telegraph Corp., Paramus, N. J., has announced the following appointments: **J. O. Paivinen,** director of engineering; **W. B. Deane,** director of systems research; **John J. Karavish,** director of subcontracting.

R. R. Williamson, director of military sales, Librascope Division of General Precision, Inc., Glendale, Calif.

Thomas A. Carter, Jr., manager of Cryogenics Division of Standard Steel Corp., Los Angeles, Calif.

M. Edward Gaydos, chief airworthiness engineer, Canadair, Ltd., Montreal, Canada, subsidiary of General Dynamics Corp.

William F. Squires, manager-sales for Army programs, General Electric Co.'s Heavy Military Electronics Department, Syracuse, N. Y.

Robert S. Lundgren, chief engineer, Pacific Moulded Products Co., Los Angeles, Calif.

Jerry D. Maxa, general sales manager, Koehler Aircraft Products Co., Dayton, Ohio, a subsidiary of New Britain Machine Co.

Gene Lott, chief engineer, Pacific Air Lines.

John H. Hanshue, procurement division manager, Lockheed's California Division, Burbank, Calif.

George Strawn, manager-Western region, Mechanical Division of General Mills, Redondo Beach, Calif.

Donald J. Povejsil, director of new product services, Westinghouse Electric Corp., Pittsburgh, Pa.

Robert K. Lowry and **George D. Pugsley,** customer service representatives, Ryan Electronics, Division of Ryan Aeronautical Co., San Diego, Calif.

Dr. Chou H. Li, head of the Materials and Techniques Research Group, General Transistor Corp., Jamaica, N. Y.

Frank S. Kipp, general operations manager of the newly established Special Military Vehicles Operations, Defense Products Group of Ford Motor Co., Dearborn, Mich. Also: **Claude A. Brosterhous,** assistant manager of Systems Tests and Prototype Fabrication for Tactical Weapons Systems Operations, Aeronutronic Division of the Defense Products Group, Newport Beach, Calif.

E. Clyde Bovee, general manager-Navy hydrofoil patrol craft program, Boeing Airplane Co., Seattle, Wash.

Warren A. Pine, Jr., development director for Latin America for Pan American World Airways, Inc.

John M. Britton, manager of research and development contract sales, Hughes Aircraft Co.'s Semiconductor Division, Newport Beach, Calif.

William Flanagan, general manager, Pacific Automation Products, Inc., Glendale, Calif., and **Dave Duff,** manager of marketing.

James H. Vaughan, director of defense products, American Car and Foundry Division of ACF Industries, Inc., New York, N. Y., and **John H. Snyder,** general purchasing agent.

Alfred Shapero, sales manager, Maryland Division of Litton Industries, College Park, Md.

B. S. Chen, manager-Design Engineering Division of Dynatronics, Inc., Orlando, Fla.

William C. Schupp, assistant chief engineer, Field Engineering Department, Barnes Engineering Co.'s laboratories, Stamford, Conn. Also: **Charles R. Layne,** in charge of the newly established Barnes Field Engineering Office at Space Technology Laboratories, Patrick AFB, Fla., and **Donald C. Chalifour** assistant to Mr. Layne.

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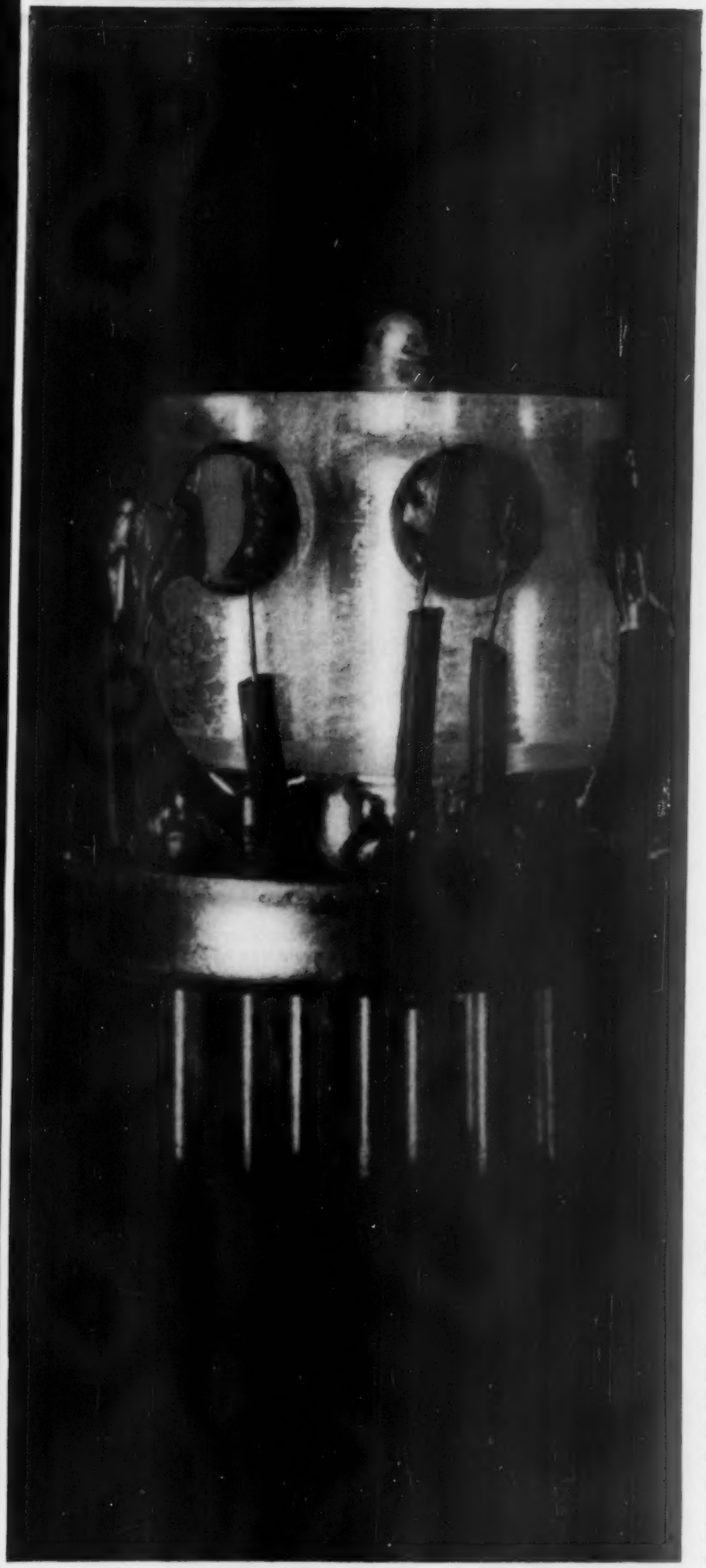

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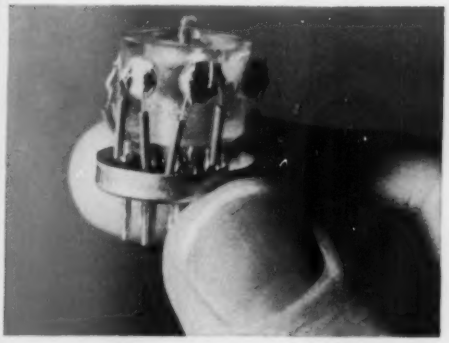

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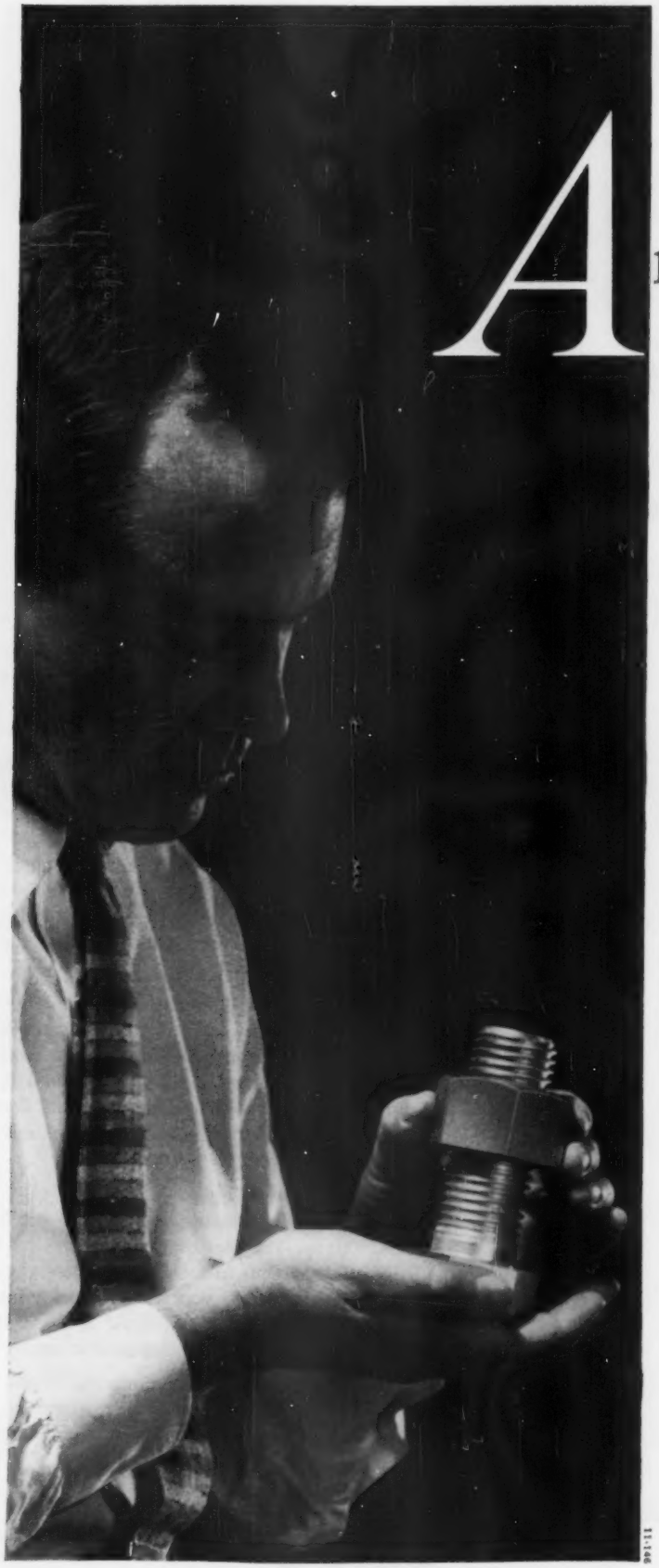

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LETTERS

'Checklist Reader'

Re: Letter "SAC Alerts," issue of July 4 (p. 102), if SAC "combat-ready B-47 copilot" McDaniel of MacDill feels "mal-assigned," I wish him a speedy exit from the Air Force. Today's professional aircrew has no place for any person unable to accept responsibility and the entire Air Force, especially SAC, can do better without this officer of "humble Century-series-bred opinions."

Does he think he is the only fighter pilot who was ever assigned to multi-engined aircraft?

My Century-series breeding did not teach me to back out of an undesirable situation, as it evidently did this officer, who "finds himself ensnared in the jaws of an organization . . . etc." Pity he cannot realize that this "organization" is not for his exclusive use. Pity even more that he cannot realize the opportunity available to him to enhance his flying ability and education by being a member of the United States Air Force, not only SAC. No, he can see no farther than the end of his checklist, and probably makes all who must associate with him miserable as he wishes it were a gunsight.

I went this same route, and it almost ended my Air Force career, but a fellow officer talking to me, much in the same way as this letter, made me realize that, today, fighter pilots are cheap but good officers are not.

Have you forgotten that you are an officer first, a pilot second?

Now as a combat-ready aircraft commander (KB-50K), I must say that should this "brash fighter jock turned checklist reader" ever be assigned to my crew, he will forever remain a checklist reader, for he apparently cannot be given the responsibility to do anything else.

1st Lt. Ernest A. Boehler, Jr.
427th Air Refueling Squadron
Langley Air Force Base, Va.

'In Praise of Quesada'

When President Eisenhower gave former Gen. E. R. "Pete" Quesada the task of changing the talk about flight safety into reality, his work was cut out for him.

Yet, because Mr. Quesada refuses to subscribe to the principle that airline pilots can do no wrong, his job has been a battle from the beginning.

Principal rival is energetic ALPA President Clarence Sayen, who has built the Air Line Pilots Assn. into a prominent and influential labor organization. He is used to making well laid plans and having them materialize. And he intends to keep things that way.

In the latest skirmish between the pilots and the Federal Aviation Agency, over where inspectors may sit aboard jets, resulting in a strike against Eastern Air Lines and mysterious "illnesses" at Pan American—the pilots demonstrated how they react when denied their own way.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

If FAA inspectors can occupy the third pilot's seat, this crew member's role is obviously unimportant. Such a revelation may make it difficult or impossible for ALPA to get the third pilot negotiated next time airline contracts expire.

In addition Sayen has before him the problem of immense pilot layoffs as jet service increases.

Combined with a ruling making 60 the compulsory retirement age, Sayen is missing no opportunities to make trouble for Mr. Quesada's organization.

But more significant than any of these problems is the fact that for the first time in his career, pilots' boss Sayen has met someone he can neither bully nor buffalo.

In addition to overhauling the CAA, "dictator" Quesada has tackled the problem of airways modernization and airport improvement.

He has achieved a better working relationship between military and civil aviation than ever before.

Largely through Quesada's insistence on rigid training, pilot transition to pure jets has been smoothly accomplished, and copilot proficiency is being brought to a new high.

It seems strange that the same airline pilots who once cried for speedier government action on aviation matters, now having the action, seek to shelve Quesada's FAA under the creaking bureaucratic hand of the CAB.

Mr. Sayen impresses no one with his abusive attacks on Administrator Quesada. And airline pilots, acting like spoiled children by defiantly resisting a back-to-work injunction, will only bring disfavor upon themselves.

In view of the recent epidemic of "illnesses" among Eastern and Pan American pilots, it would appear that compulsory retirement at 45 or 50 would be more in keeping with their frail physical condition.

Nick Bez, Jr.
Seattle, Wash.

Civil Defense

In my position as Executive Director of Miami Valley Civil Defense Authority, I have been a subscriber to Aviation Week for some time, mainly because of the information that is available in Aviation Week. In reference to our defense ability and capability (AW June 27, p. 21), the editorial by Mr. Robert Hotz was extremely well written and very factual. However, without criticizing any of the editorial and the information published in Aviation Week, I would like to bring to the attention of the editorial staff a public service that could be done for our nation that could be accomplished in no other manner.

Civil defense is looked upon as a stepchild by many people and officials, yet as you look through the advertisements in Aviation Week all of them pertain to national industry which employs civilian workers. There is no advertisement in Aviation Week on the part of the military services where they are building any piece of equipment, aircraft, missile, computer and various electronic equipment, so we come to the basic reason for Civil Defense, which is to protect the civilian workers of industry who must manufacture the material and equipment used by the military services.

Our military services are no stronger than the weakest link, and today our weakest link is in the protection of the civilian workers and their families.

If this nation is to continue to be a leader, industry must accept some of the responsibility to provide survival for the civilian workers.

Only by such survival can industry maintain top speed in providing the military services with equipment needed to provide retaliatory ability and a deterrent to any nation which would think of attacking our country.

It would be very enlightening, I am sure not only to the officials of our nation but to industry, to find in Aviation Week an editorial to remind them that it is industry and civilian workers who provide the know-how and ways and means of providing the military services with their needs.

Stewart Sheldon
Executive Director
Miami Valley Civil Defense Authority
Dayton, Ohio

Slick CL-44 Order

The management of Slick Airways has for years been an interested reader of Aviation Week and considered it as one of the best informed sources in the field of aviation in this country.

We read with particular interest the air transport article entitled "Cargo Award Spurs Turboprop Activity" in your July 4 issue (p. 40). This is a well written article which explains with clarity the present day climate in which commercial airlines bid for government airlift contracts; however, there is a seriously erroneous statement in the article to the effect that Slick's loss of the Logair contract will affect its Canadair CL-44D turboprop air freighter order.

The fact is the loss of this contract will in no way alter our order. Slick is definitely committed for the purchase of these aircraft and is proceeding with plans to use them on its common carriage routes.

Except in the event of national emergency, no plans exist to use them on government contracts.

Robert A. Colhoun
Assistant to the Executive
Vice President
Slick Airways, Inc.
Washington, D.C.

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